OCS Report
MMS 96-0068

Oil-Spill Risk Analysis: Beaufort Sea Outer Continental Shelf Lease Sale 170

U.S. Department of the Interior
Minerals Management Service
Branch of Environmental Operations & Analysis

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Introduction

The Federal Government has proposed to offer Outer Continental Shelf (OCS) lands in the Beaufort Sea for oil and gas leasing. The estimated amounts of oil resources likely to be leased, discovered, and produced as a result of the Beaufort Sea OCS Lease Sale 170 are assumed to range between 0.35 billion barrels (Bbbl) and 0.67 Bbbl. This report examines the probabilities of occurrence and contact from hypothetical oil spills if leases are issued and commercial quantities of oil are found and produced from OCS Lease Sale 170.

Because oil spills may occur from activities associated with offshore oil production and transportation, the Minerals Management Service (MMS) formally assesses risk of hypothetical oil-spills. When evaluating the significance of accidental oil spills, it is important to remember that the occurrence of such spills is fundamentally a matter of probability. No one can certify the volume of oil that would be produced, or the size or likelihood of a spill that would occur, during the assumed 21-year production life (2006-2026) of the lease. Neither can factors that affect spills such as the wind, ocean current, or ice conditions be known for certain. Although some of this uncertainty is due to incomplete and imperfect data, a considerable of uncertainty amount exists simply because future events are difficult to estimate. For example, a probabilistic event such as an oil-spill occurrence cannot be predicted—only an estimate of its likelihood or probability can be quantified. However, the possible effects of oil spills that could occur from oil and gas production must be considered in the leasing decision. To maintain perspective, each potential effect must be associated with a quantitative estimate of its probability of occurrence.

This report summarizes results of the oil-spill risk analysis (OSRA) conducted for the proposed Beaufort Sea OCS Lease Sale 170. The objective of this analysis was to estimate the relative oil-spill risks associated with oil and gas production from the leasing alternatives proposed for the lease sale. The MMS will analyze the oil-spill risks in the environmental impact statement (EIS) prepared for the lease sale. A description of the OSRA model used in this analysis can be found in previous papers (Smith et al., 1982; LaBelle and Anderson, 1985).

The analysis for proposed OCS Lease Sale 170 was conducted in three parts, corresponding to different aspects of the overall situation.

- The first part addressed the probability of oil-spill occurrence.
- The second addressed trajectories of oil spills from hypothetical spill sites to various environmental resource areas or land segments.
- The third part combined the results of the first two to estimate the combined oil-spill risk if there is oil production as a result of the lease sale.

Summary of the Proposed Action

The proposed action (Alternative 1) offers for lease a portion of OCS lands in the Beaufort Sea. The OSRA study area extends from lat. 68° N. to 74° N. and from long. 134° W. to 176° W. (fig. 1). The proposed leasing area consists of 302 blocks (488.5 hectares) located in the Beaufort Sea (fig. 1). This area is located 4.8-40.3 km offshore and lies in waters that are 7.6-36.6 m deep. Trajectories were simulated from 344 hypothetical spill sites in the proposed sale area. These spill sites were grouped into 8 larger hypothetical spill launch areas (L1-L8), which were used to represent areas for hypothetical platform spill occurrences (fig. 2). The scenario (that which is likely to be leased, discovered, and produced) for the proposed action assumes production and transportation ranging from 0.35 Bbbl to 0.67 Bbbl of oil.

The transportation scenario assumes that the crude oil produced in hypothetical launch areas 1 through 8 will be transported by pipeline to shore with potential landfalls at Oliktok Point, Point McIntyre, and Bullen Point (fig. 3). These hypothetical offshore pipeline route segments (P1-P7) are used to represent spill risks from oil transportation. It is assumed that the oil is then transported by onshore pipeline to Pump Station #1 of the Trans-Alaska Pipeline System.

Summary of the Alternatives

Only alternatives that were judged to be "economic" were analyzed in the OSRA. The only deferral alternative analyzed, the Kaktovik Deferral Alternative, is shown in figure 4. The volume of oil resources for this alternative was assumed to be 0.31-0.55 Bbbl distributed throughout Launch Areas 1-8. The deferral alternative was analyzed by using the combined probabilities (representing oil-spill occurrence and contact), which excluded oil resources assumed (in the base case) to be located in portions of Launch Areas 7 and 8 (as shown in fig. 2).

Framework of the Analysis

The oil-spill risk analysis depends not only on the meteorologic, oceanographic, geographic, and sea-ice conditions of the study area, but also on the environmental resource areas at risk from oil spills and the estimated volume of oil resources assumed to be leased, discovered, produced, and transported.

Environmental Resource Areas

Environmental resource areas were selected by the MMS analysts in the Alaska OCS Region who prepare the EIS for the lease sale. Appendix A (figs. A-1 through A-7) contains maps showing the digitized environmental resource area locations. The locations of 32 environmental resource areas were digitized in the same coordinate system, or base map, used for the trajectory simulations. These resource areas are composed of Ice/Sea Segments 1-17, 6 bays and lagoons (Peard Bay, Elson Lagoon, Simpson Lagoon, Gwydry Bay, Jago Lagoon, and Beaufort Lagoon), Subsistence Resource Areas A-D, Fall Feeding Area, Summer Feeding Areas 1-2, and Northern and Southern Spring Lead Areas. Each environmental resource area that is typically present year-round was treated as being vulnerable to oil all year. This method assumes that the environmental resource area is sensitive to oil-spill effects throughout the entire year rather than seasonally. Each environmental resource area not usually present year-round was treated as vulnerable to contact from oil spills only during the months it is likely to be present. Several resource areas were analyzed as being vulnerable on both an annual and a seasonal basis. The digitized environmental resource areas, their months of vulnerability, and the illustration depicting their locations are listed below.

Because the trajectory model simulates an oil spill as a point, each environmental resource area was digitized with an areal extent slightly greater than it actually occupies. For example, the shoreline environmental resource areas extend a short distance offshore, thus allowing the model to simulate a spill that approaches and partially contacts the environmental resource area (or boundary segment), then withdraws and continues along its path. For this analysis, the trajectory simulations were calculated for two seasons—winter (October-June) and summer (July-September).

Environmental Resource Area	**Months Assumed Vulnerable**	**Figure**
Ice/Sea Segments 1-17	January-December	A-1
Ice/Sea Segments 1-4*	May-June	A-1
Peard Bay	June-October	A-2
Elson Lagoon, Simpson Lagoon, Gwydry Bay, Jago Lagoon, and Beaufort Lagoon	July-September	A-2
Subsistence Resource Areas A-D	January-December	A-3, A-4
Fall Feeding Area	September-October	A-3
Summer Feeding Areas 1 and 2	June-September	A-3, A-4
Southern and Northern Spring Lead System Areas	January-December	A-5, A-6
Northern Spring Lead System Area*	May-June	A-5

* These resources were analyzed as vulnerable year-round and separately as vulnerable only in specific months.

In order to quantify spill trajectories that may travel out of the study area, the locations of 38 boundary segments (B1-B38) located along the edges of the study area were also digitized in the same coordinate system used for the trajectory simulations (fig. A-7). Each boundary segment was treated as being *vulnerable* all year.

Also included in the analysis was an additional environmental resource area, land, which comprised the entire study area coastline. Upon contacting land, the trajectory simulation is ended. Land was further analyzed by dividing the study area coastline into 61 land segments of approximately equal lengths (24 km), as shown in figure 5.

Estimated Volume of Oil Resources

For this analysis, both benefits and risks are functions of the volume of oil and are mutually dependent. For example, greater volumes of oil are associated with greater economic benefits as well as greater risks. If the benefits are evaluated by assuming production of a specific amount of oil, then the corresponding risks should be stated conditionally, such as "the risks are . . . , given that the volume is . . . ." Any statements about the likelihood of a particular volume of oil being present apply equally to the likelihood of the corresponding benefits and risks.

The estimated volumes of oil resources used for oil-spill risk calculations in this report correspond to those that will be used in the draft EIS for the lease sale (approval memorandum from Chief, Resource Evaluation Division, dated October 16, 1996). The hypothetical development and transportation scenario for the proposed action is contingent on an assumed range of 0.35 Bbbl to 0.67 Bbbl of oil.

It should be emphasized that these estimates and the following analyses assume that geologically recoverable quantities of oil are present. If no geologically recoverable quantities of oil are present, no oil-spill risks exist from OCS production.

Oil-Spill Risk Analysis (OSRA)

The OSRA consists of three parts: (1) the probability of oil spills occurring, (2) the trajectory simulation of oil spills, and (3) the combination of oil-spill occurrence probabilities and trajectory simulations. Contingent upon actual discovery of geologically recoverable quantities of oil, exploration and development are assumed to take place over 12 years (1999-2010), and production is assumed to span a period of 21 years (2006-2026).

Probability of Oil Spills Occurring

The probability of oil spills occurring (given that geologically recoverable quantities of oil are present) assumes that spills occur independently of each other as a Poisson process. The Poisson process is a statistical distribution commonly used to model random events. The probability of oil spills occurring is based on a spill rate derived from past OCS platform and pipeline experience in U.S. waters, and depends on the volume of oil produced and transported. All types of accidental spills greater than or equal to 1,000 barrels (bbl) were considered in this analysis. These spills include not only well blowouts but also other accidents that occur on platforms and during transportation of oil to shore. These accidents were classified as either platform or pipeline spills. This classification allows the analyst to compare the risks from each spill source between the proposed action and any alternatives.

Anderson and LaBelle (1994) examined oil-spill occurrence rates applicable to the U.S. Outer Continental Shelf. Their results, adjusted for recent experience and based upon more complete databases than were available for earlier analyses (Anderson and LaBelle, 1990; Lanfear and Amstutz, 1983), indicated some significant changes in the spill rates for platforms and pipelines. This report uses these updated spill occurrence rates.

Spill rates are expressed as number of spills per billion barrels (spills/Bbbl) of oil produced or transported. Only spills greater than or equal to 1,000 bbl are addressed because smaller spills may not persist long enough to be simulated by trajectory modeling. Another consideration is that a large spill is likely to be identified and reported; therefore, these records are more comprehensive than those of smaller spills. (Small, chronic spillage is addressed in MMS's environmental analyses without the use of trajectory modeling.)

Two basic criteria were used in selecting the risk exposure variable: (1) the exposure variable should be simple to define and (2) it should be a quantity that can be estimated. The volume of oil produced or transported was the chosen exposure variable primarily for the following reasons: historic volumes of oil produced and transported are well documented, using these volumes makes the calculation of the estimated oil-spill occurrence rate simple—the ratio of the number of historic spills to volume of oil produced or transported, and future volumes of oil production and transportation are routinely estimated. Estimates of volume are prepared by MMS Resource Evaluation program analysts; their function and expertise involve the assessment of oil resources by using comprehensive geological and geophysical databases and related models. In addition, the MMS analysts estimate most other exposure variables, such as number of platforms and tanker trips, as a function of the volume of oil produced or transported.

Anderson and LaBelle (1994) analyzed platform and pipeline spills that occurred on the U.S Outer Continental Shelf from 1964 through 1992. In these analyses, every spill record was examined and verified to the furthest extent possible. Each spill was classified according to its applicability to the analysis for size, product spilled, and spill source.

In an earlier analysis (Anderson and LaBelle, 1990), nonparametric tests were applied to determine whether OCS platform and pipeline spills from 1964 through 1987 were random and independent. For these observations, the volume of oil produced and transported between spills appeared to be nonrandom, increasing over time. Extending the data through 1992, Anderson and LaBelle (1994) showed that the OCS platform spill rate continued to decline. However, with the occurrence of four pipeline spills between 1988 and 1992, there was no longer any evidence of a corresponding decrease in the estimated OCS pipeline spill occurrence rate.

For spills greater than or equal to 1,000 bbl, the spill rates are 0.45 spills/Bbbl of produced oil for U.S. Outer Continental Shelf platforms and 1.32 spills/Bbbl of transported oil for U.S. Outer Continental Shelf pipelines. The platform spill rate reflects the observed decline in spill occurrence mentioned above. This rate is based on the most recent 73 percent of the production record, which includes only 27 percent of the historic platform spills (3 spills/6.6 Bbbl). The pipeline spill rate of 1.32 spills/Bbbl is based on the entire OCS production (transportation) and pipeline spill records (12 spills/9.1 Bbbl).

In summary, the spill rates (expressed as number of spills $\geq$ 1,000 bbl/Bbbl of produced or transported oil) used in this report are as follows:

Platforms—0.45 spills/Bbbl
Pipelines—1.32 spills/Bbbl

Oil-spill occurrences (spills $\geq$ 1,000 bbl) are considered to be governed by a Poisson process (Smith et al., 1982; Lanfear and Amstutz, 1983). The probability of a specific number of spills $p(n)$ occurring is described by the Poisson distribution:

$$p(n) = \frac{e^{-\lambda} * \lambda^{n}}{n!}$$

where n is the specific number of spills (0, 1, 2, …, n), e is the base of the natural logarithm, and λ is the parameter of the Poisson distribution. For oil spills, the Poisson parameter (λ) is equal to the spill rate multiplied by the volume of oil to be produced or transported. The spill rate has dimensions of number of spills/Bbbl, and the volume is expressed in Bbbl. Therefore, λ denotes the mean number of spills estimated to occur as a result of production or transportation of a specific volume of oil.

Oil-spill occurrence estimates for spills greater than or equal to 1,000 bbl were calculated for production and transportation of oil during the assumed production life of the proposed action (2006-2026). Table 1 shows the mean number of spills estimated to occur and the probability of one or more spills occurring in the study area over the assumed production life of the proposed lease sale.

This analysis addresses only the risk of platform and pipeline spills from the production and transportation (via offshore pipeline) of Beaufort OCS Lease Sale 170 resources to the Trans-Alaska Pipeline System. Historically, North Slope crude transported via the Trans-Alaska Pipeline System has been loaded onto tankers at Valdez, Alaska (the pipeline terminus) and shipped to the U.S. west coast and other destinations. These crude oil movements have a historic spill rate of 1.10 spills ($\geq$ 1,000 bbl) per billion barrels handled (Anderson and LaBelle, 1994). Using this rate and assuming Beaufort OCS Lease Sale 170 resources are transported by tanker from Valdez, the mean number of spills and the probability of one or more spills associated with the movement of the North Slope crude from Valdez occurring outside the study area are estimated as follows:

Mean Number of Spills:	0.38-0.74
Probability of One or More Spills:	32-52%

Oil-Spill Trajectory Simulations

The trajectory simulation portion of the model consists of many hypothetical oil-spill trajectories that collectively represent the mean surface transport and the variability of the surface transport as a function of time and space. The trajectories represent the Lagrangian motion that a particle on the surface might take under given wind, ice, and ocean current conditions. Multiple trajectories are simulated to give a statistical representation, over time and space, of possible transport under the range of wind, ice, and ocean current conditions that exist in the area.

Trajectories are constructed from simulations of wind-driven and density-induced ocean flow fields, and the ice motion field. The basic approach is to simulate these time and spatially dependent currents separately, then combine them through linear superposition to produce an oil-transport vector. This vector is then used to create a trajectory. Simulations are performed for two seasons, winter (October-June) and summer (July-September). The choice of this seasonal division was based on meteorological, climatological, and biological cycles, as well as consultation with Alaska Region EIS analysts. The modeling of each ice motion field and ocean current component is detailed in Hedström, Haidvogel and Signorini (1995) and Hedström (1994). Brief summaries of the method and assumptions follow.

For cases where the ice concentration is below 80 percent, each trajectory is constructed using vector addition of the ocean current field and 3.5 percent of the instantaneous wind field—a method based on work done by Huang and Monastero (1982), Smith et al. (1982), and Stolzenbach et al. (1977). For cases where the ice concentration is 80 percent or greater, the model ice velocity is used to transport the oil. Equations 1 and 2 show the components of motion that are simulated and used to describe the oil transport:

$$U_{oil} = U_{current} + 0.035\, U_{wind} \qquad (1)$$

or

$$U_{oil} = U_{ice} \qquad (2)$$

where: U_{oil} = oil drift vector
$U_{current}$ = current vector (when ice concentration $<$ 80%)
U_{wind} = wind speed at 10 m above the sea surface
U_{ice} = ice vector (when ice concentration $\geq$ 80%)

The wind drift factor was estimated to be 0.035, with a variable drift angle ranging from 0° to 25° clockwise. The drift angle was computed as a function of wind speed according to the formula in Samuels et al. (1982). (The drift angle is inversely related to wind speed.)

For each trajectory simulation, the start time for the first trajectory was the first day of the season (winter or summer) of the first year of wind data (1978) at 6 a.m. Greenwich Mean Time (GMT). Each subsequent trajectory was started every 1.5 days on average, at 6 a.m. GMT. A total of 2,000 trajectories (1,500 in winter, 500 in summer) was launched from each of the 344 hypothetical spill sites distributed over the proposed lease sale area over the 9 years of wind data (1978-1986). Results of these trajectory simulations were combined into eight hypothetical launch areas (L1-L8) to represent platform risk (fig. 2). Transportation risks were represented by 2,000 trajectories launched uniformly along each hypothetical pipeline route (P1-P7—fig.3).

For the Beaufort/Chukchi Sea, the U_{current} and U_{ice} are simulated using a three-dimensional coupled ice-ocean hydrodynamic model (Hedström et al., 1995; Hedström, 1994). The model is based on the ocean model of Haidvogel et al. (1991) and the ice model of Hibler (1979). The location of each trajectory at each time interval is used to select the appropriate ice concentration. Depending on the ice concentration, either the ice or water velocity with wind drift from the stored results of the Haidvogel et al. (1991) coupled ice-ocean model is used (see equations (1) and (2) above). Surface transport of the oil slick for each spill was simulated as a series of straight-line displacements in 3-hour increments of a point governed by the U_{oil} vectors.

The trajectories age while they are in the water/on the ice. For each day that the hypothetical spill is in the water, the spill ages—up to a total of 30 days. While the spill is in the ice ($\geq$ 80% concentration), the aging process is suspended. The maximum time allowed for the transport of oil in the ice is 180 days after which the trajectory is terminated. The 30-day limit is maintained for spill trajectories in open water.

Summer trajectories are those that start between the beginning of July and the end of September. Therefore, if any contact to an environmental resource area or land segment is made by a trajectory that began at the end of September, it is considered a *summer contact* and is counted along with the rest of the contacts from spills launched in the summer.

The wind data set used came from the National Weather Service Limited Fine Mesh (LFM) model (Gerrity, 1977), and the 9-year simulation covered both the low frequency variability and interannual variability. A major assumption used in this analysis is that the ice motion velocities and the ocean daily flows calculated by the coupled ice-ocean model adequately represent the flow components. Sensitivity tests and comparisons with data illustrate that the model captures the first-order transport and the dominant flow (Hedström et al., 1995).

After quality assurance checks (performed by MMS) were passed, the trajectories were used in the OSRA model structure. The OSRA model was run, given the land/sea segments and environmental resource areas specified for this analysis. Plots of trajectories and overlays of land/sea segments and environmental resource areas were examined to ensure that contacts were properly established and tabulated. The quality assurance checks provide an important means of gaining information and insight into the behavior of the simulated trajectories. The conditional probabilities of contact (tables 2 through 9 and appendices B and C) offer the analyst much oceanographic information. Some summary information is provided below to help identify the particular trajectory behavior.

When examining any one trajectory, it is important to be aware of the relative scales or sizes of the flow components that have been combined to produce the final U_{oil} vector. The wind-induced surface drift is the dominant component of U_{oil} except where the density-induced circulation is very strong or where the ice concentration is greater than or equal to 80 percent. In addition, the wind-driven flow component contains seasonal trends as well as a large degree of variability. Because many other factors are related to wind forcing (such as mixing in the surface layer and biological, chemical, and physical processes), it is useful to compare the envelopes of the trajectories to seasonal mixing regimes and processes. Some information can be gained by comparing trajectories from winter versus summer (when wind speeds and ice concentration are high versus low).

The second dominant transport factor is the density-induced flow. This forcing results in well-organized, coherent envelopes that follow the general trend of the coastline. The degree to which wind forcing plays a role in the nearshore areas has been studied as part of the Beaufort Mesoscale Circulation Study (Aagaard et al., 1990), and there is often a reinforcement of the wind-driven component by the density-driven component.

An important test is to compare observed drifter tracks with trajectories. Some historic data exist (Colony and Thorndike, 1984; Aagaard et al., 1990), but comparing drifter tracks with trajectories must be done carefully, especially considering the ice station trajectories. Ice stations on large flows that are at the ice edge move differently than ice stations in the pack ice. In general, the results of the coupled ice-ocean hydrodynamic model show these features at the correct location and magnitude, meeting the zero-th order test of the basic model. As expected, the simulated trajectories appear more variable than these drifter tracks. To a large degree, the U_{oil} transport vector has components of wind-driven and surface-driven motion. Thus, the observations and simulations contain similar trends, but an exact match should not be expected.

In conclusion, the spill trajectories for Beaufort Sea OCS Lease Sale 170 show distinct variations in response to the seasonal wind patterns and the strength of density-driven currents. Hypothetical spills on the shelf show the wind-induced variability and the relatively important density-driven current along the Beaufort Sea coast. Landfall or contact of the trajectories is generally highest year-round for points located west of the launch areas, with contacts east of these areas occurring in the summer.

As the simulated oil spills moved, any contacts with environmental resource area were recorded. Spill movement continued until the spill contacted land, moved out of the study area, or aged more than 30 days in open water or 180 days in ice conditions.

The trajectories simulated by the model represent hypothetical pathways of oil slicks; they do not directly consider cleanup, dispersion, or weathering processes that could determine the quantity or properties of the oil that might eventually contact environmental resource areas or land segments. An implicit analysis of weathering and decay can be considered by noting the age of simulated trajectories when they contact environmental resource areas. For this analysis, the periods selected were 3, 10, and 30 days (180 days in ice conditions) to represent implicit measures of oil weathering as well as matters relating to containment and cleanup.

Conditional Probabilities

The probability that an oil spill will contact a specific environmental resource area within a given time of travel from a certain location or spill site is termed a *conditional probability*, the condition being that a spill is assumed to have occurred. Conditional probabilities of contact for 3, 10, and 30 days (180 days in ice conditions) were calculated for the eight hypothetical launch areas shown in figure 2 (referred to as L1-L8) and for the transportation segments shown in figure 3 (referred to as P1-P7). These annual conditional probabilities of contact with environmental resource areas and land segments are presented in tables 2 through 9 and, on a seasonal basis in appendices B and C.

Combined Analysis of Oil-Spill Occurrence and Oil-Spill Trajectory Simulations

A critical difference exists between the *conditional probabilities* and the *combined probabilities* calculated in this part of the OSRA. Conditional probabilities assume that a spill has occurred and, thus, depend only on the winds, ice, and ocean currents in the study area. Combined probabilities, on the other hand, depend not only on the physical conditions, but also on the chance of spill occurrence, the estimated volume of oil to be produced or transported, and the oil transportation scenario. These additional variables make the combined probabilities sensitive to the course of action chosen by the decisionmaker, that is, choosing to lease or not to lease certain tracts or implementing specific transportation stipulations. The annual combined probabilities for this analysis are presented in tables 10 and 11.

In calculating the *combined probabilities*, those that represent probabilities of both oil-spill occurrence **and** contact, the following steps are performed.

1. For a set of n_t environmental resource areas and n_l spill sites, the conditional probabilities can be represented in a matrix form. Let [C] be an n_t x n_l matrix, where each element $c_{i,j}$ is the probability that an oil spill will contact environmental resource area i, given that a spill occurs at hypothetical spill site j. Note that spill sites can represent potential spill starting points at production areas or transportation routes.

2. Spill occurrence can be represented by another matrix [S]. With n_l spill sites and n_s production sites, the dimensions of [S] are n_l x n_s. Let each element $s_{j,k}$ be the estimated mean number of spills occurring at spill site j owing to production of a unit volume (1 Bbbl) of oil at site k. These spills can result from either production or transportation. The $s_{j,k}$ can be determined as a function of the volume of oil (spills/Bbbl). Each column of [S] corresponds to one production site and one transportation route. If alternative and mutually exclusive transportation routes are considered for the same production site, they can be represented by additional columns of [S], thus increasing n_s.

3. Matrix [U] is defined as:

$$[U] = [C] \times [S]$$

Matrix [U]—which has dimensions n_t x n_s—is termed the *unit risk matrix*. Each element $u_{i,k}$ corresponds to the estimated mean number of spills occurring and contacting environmental resource area i, owing to the production of a unit volume (1 Bbbl) of oil at site k.

4. With [U], the mean number of contacts to each environmental resource area are estimated, given a set of oil volumes at each site. Let [V] be a vector of dimension n_s where each element v_k corresponds to the volume of oil expected to be found at production site k. Then, if [L] is a vector of dimension n_t, where each element λ_i corresponds to the mean number of contacts to environmental resource area i, the formula is:

$$[L] = [U] \times [V]$$

Thus, estimates of the mean number of oil spills ($\geq$ 1,000 bbl) that will both **occur and contact** environmental resource areas (or land segments) can be calculated. (Note that as a statistical parameter, the mean number can assume a fractional value, even though fractions of oil spills have no physical meaning.)

Using Bayesian techniques, Devanney and Stewart (1974) showed that the probability of n oil-spill contacts can be described by a negative binomial distribution. However, Smith et al. (1982) noted that when actual exposure is much less than historic exposure, as is the case here, the negative binomial distribution can be approximated by a Poisson distribution. The Poisson distribution has a significant advantage in calculations because it is defined by only one parameter, the assumed number of spills. Thus, the matrix [L] contains all the information needed to use the Poisson distribution—if $P(n,i)$ is the probability of exactly n contacts to environmental resource area i, then:

$$P(n,i) = \frac{\lambda_i^{\,n} * e^{-\lambda i}}{n!}$$

Discussion

The proposed action, which assumes production and transportation of 0.35-0.67 Bbbl of oil, has an estimated mean number of 0.62-1.19 spills greater than or equal to 1,000 bbl occurring (0.16-0.30 from platforms and 0.46-0.89 from pipelines) as shown in table 1. There is an estimated 46- to 70-percent probability that a spill ($\geq$1,000 bbl) may occur as a result of this action (see table 1).

There are estimated conditional probabilities (expressed as percent chance) of 7-19 percent that a spill originating from **coastal** launch areas (L2, L4, L6, L8) will contact land within 3 days; however, launch areas **farther offshore** (L1, L3, L5, L7) have probabilities of 2-3 percent (table 2). Within a 10-day period, these probabilities increase to 12-26 percent from the coastal launch areas and 7-8 percent from the launch areas further offshore (table 3). The estimated probabilities of a spill originating from any of these launch areas contacting land within 30 days are 12-35 percent (table 4). The estimated probabilities of a spill originating from any of the eight launch areas contacting land within 180 days (in ice conditions) are 23-58 percent (table 5).

The highest estimated probabilities of contact to land from transportation segments are from pipeline segments P5 through P7 (all three are pipeline segments that make landfall—see fig. 3). The estimated conditional probabilities that a spill originating from these three segments will contact land within 3 days are 8-15 percent (table 2). These probabilities increase to 15-20 percent within 10 days (table 3) and 22-26 percent within 30 days (the longest period that spills were assumed to persist in open water) (table 4). These probabilities increase to 50-51 percent within 180 days (in ice conditions) (table 5). The remaining pipeline segments have estimated probabilities of contact similar to those of the launch areas in which they are located.

In general, only environmental resource areas located over areas of the lease offering have high (≥12%) probabilities of being contacted by a spill from the proposed lease area or its related transportation segments within 3 days (table 2). For example, Subsistence Resource Area C has a 99.5-percent-or-greater estimated conditional probability of being contacted within 3 days from spills originating at L2, L4, P1, P2 and P5-P7, and Subsistence Area D has a 99.5-percent-or-greater estimated conditional probability of being contacted within 3 days from spills originating at L6-L8, P3, P4, and P7 (see table 2).

Tables 6 through 9 list the annual conditional probabilities of one or more spills contacting a specific land segment (fig. 5) within a 3-, 10-, 30-day period (the longest period that spills were assumed to persist in open water) and 180-day period (in ice conditions). Generally, each land segment is at greatest risk of being contacted from spills originating at sources immediately to its north. The conditional probability of any one land segment being contacted within 30 days does not exceed 11 percent from any launch area (from L8 to land segment 40) or 16 percent from any pipeline segment (from P6 to land segment 34). Within 180 days, the probabilities of contacting any one land segment increase to a maximum of 16 percent from any launch area (from L8 to land segment 38) and 27 percent from any pipeline segment (from P6 to land segment 34).

Table 10 presents the estimated combined probabilities of one or more spills greater than or equal to 1,000 bbl **occurring and contacting** environmental resource areas for the proposed action as a result of the production and transportation scenarios. The combined probabilities that one or more spills (≥ 1,000 bbl) will occur and contact land within 3 days are 5-9 percent. These probabilities of occurrence and contact are 8-15 percent within 10 days, and 12-21 percent within 30 days (the longest period that spills were assumed to persist in open water). Within 180 days (in ice conditions), these probabilities are 23-40 percent. The risk of one or more spills occurring and contacting an environmental resource area within 3 days is greatest for Subsistence Resource Areas C (40%-62%) and D (30%-49%). These probabilities increase by no more than 2 percentage points within 10 and 30 days (maximum time in open water), and they increase by no more than 5 percentage points within 180 days (in ice conditions) (43-65% for Area C and 33-54% for Area D).

Table 11 shows the range of estimated combined probabilities of one or more spills greater than or equal to 1,000 bbl **occurring and contacting** land segments as a result of the production and transportation scenarios. These probabilities do not exceed 2-4 percent within a 30-day period (maximum time in open water). Within 180 days (in ice conditions), the probabilities of one or more spills occurring and contacting land segments do not exceed 4-8 percent. The highest probability of one or more spills occurring and contacting a land segment within 30 days is for Land Segment 34 (2-4%), which is located between Oliktok Point and Point McIntyre (fig. 3).

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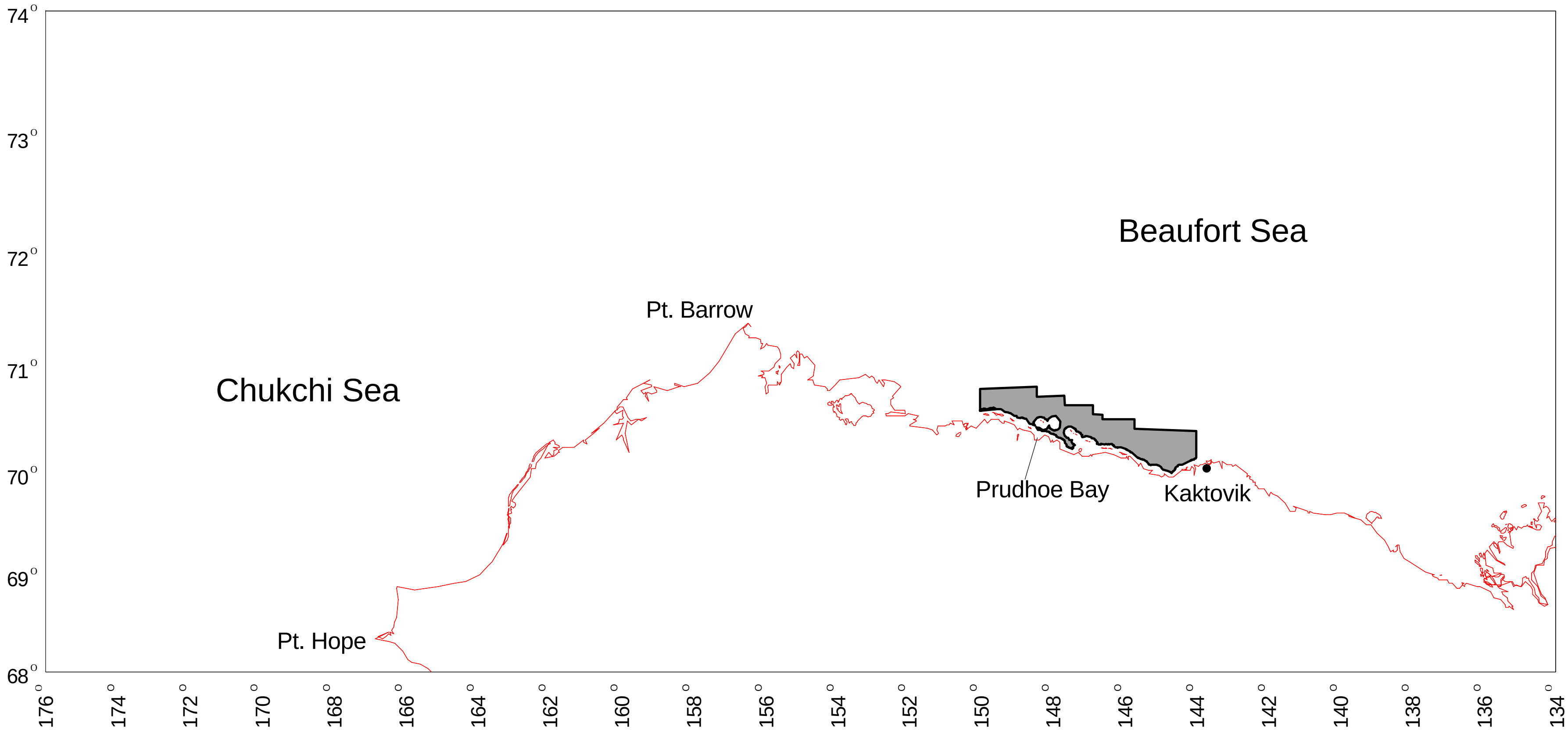

Figure 1. Study area and proposed lease sale area (shaded) for proposed Beaufort Sea OCS Lease Sale 170.

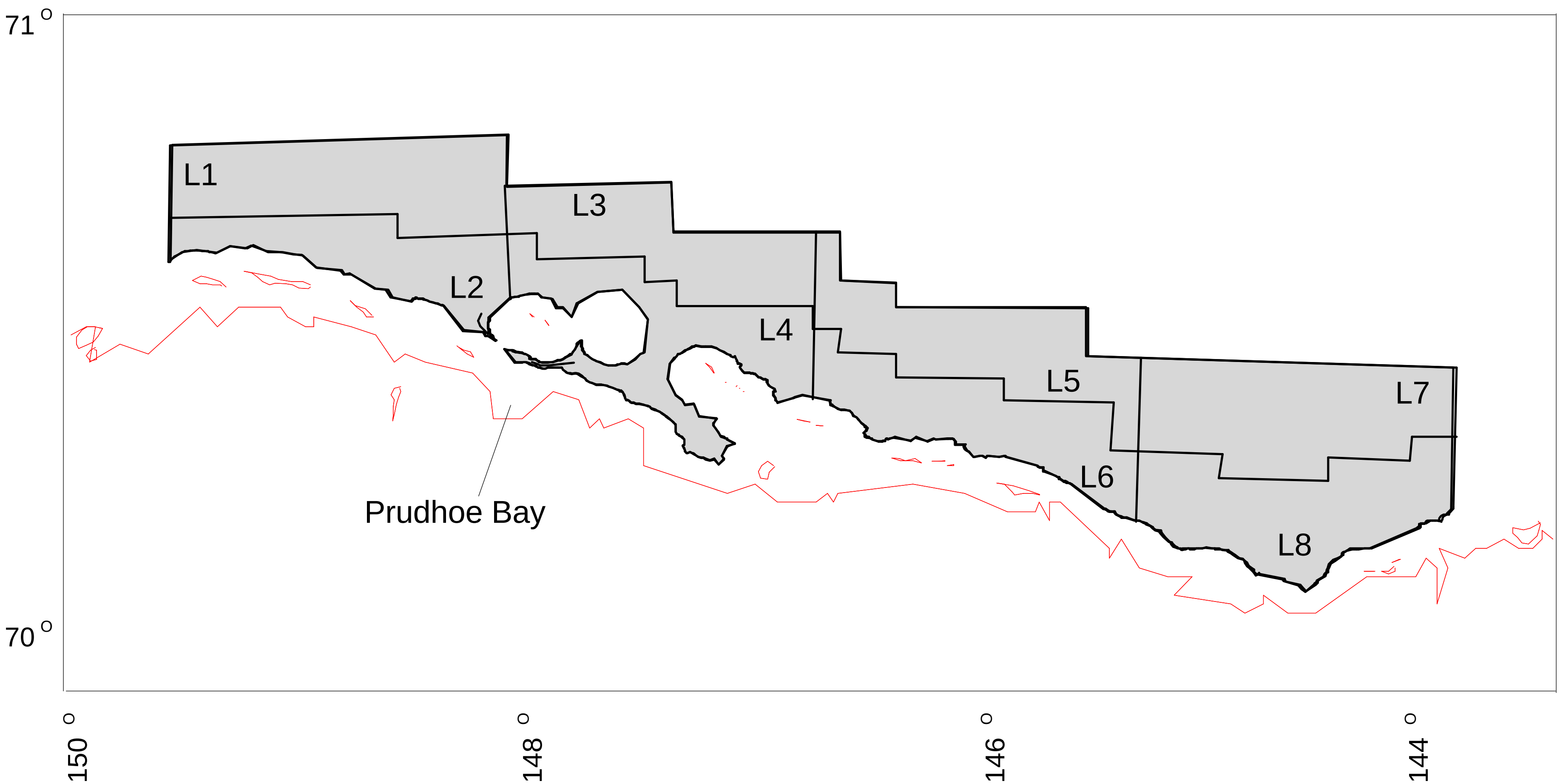

Figure 2. Enlarged representation of launch areas (L1-L8) for proposed Beaufort Sea OCS Lease Sale 170.

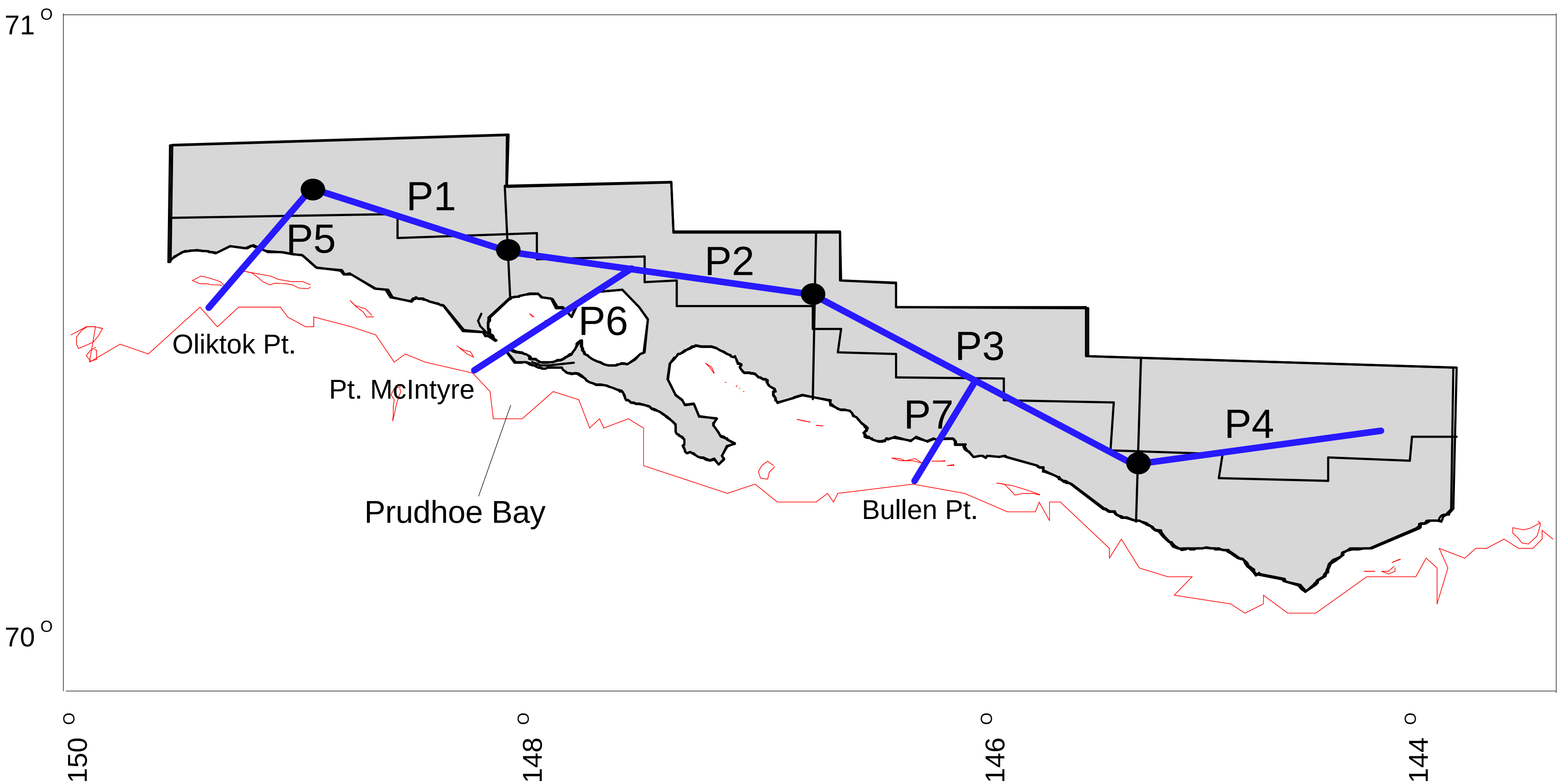

Figure 3. Enlarged representation of pipeline route segments (P1-P7) for proposed Beaufort Sea OCS Lease Sale 170.

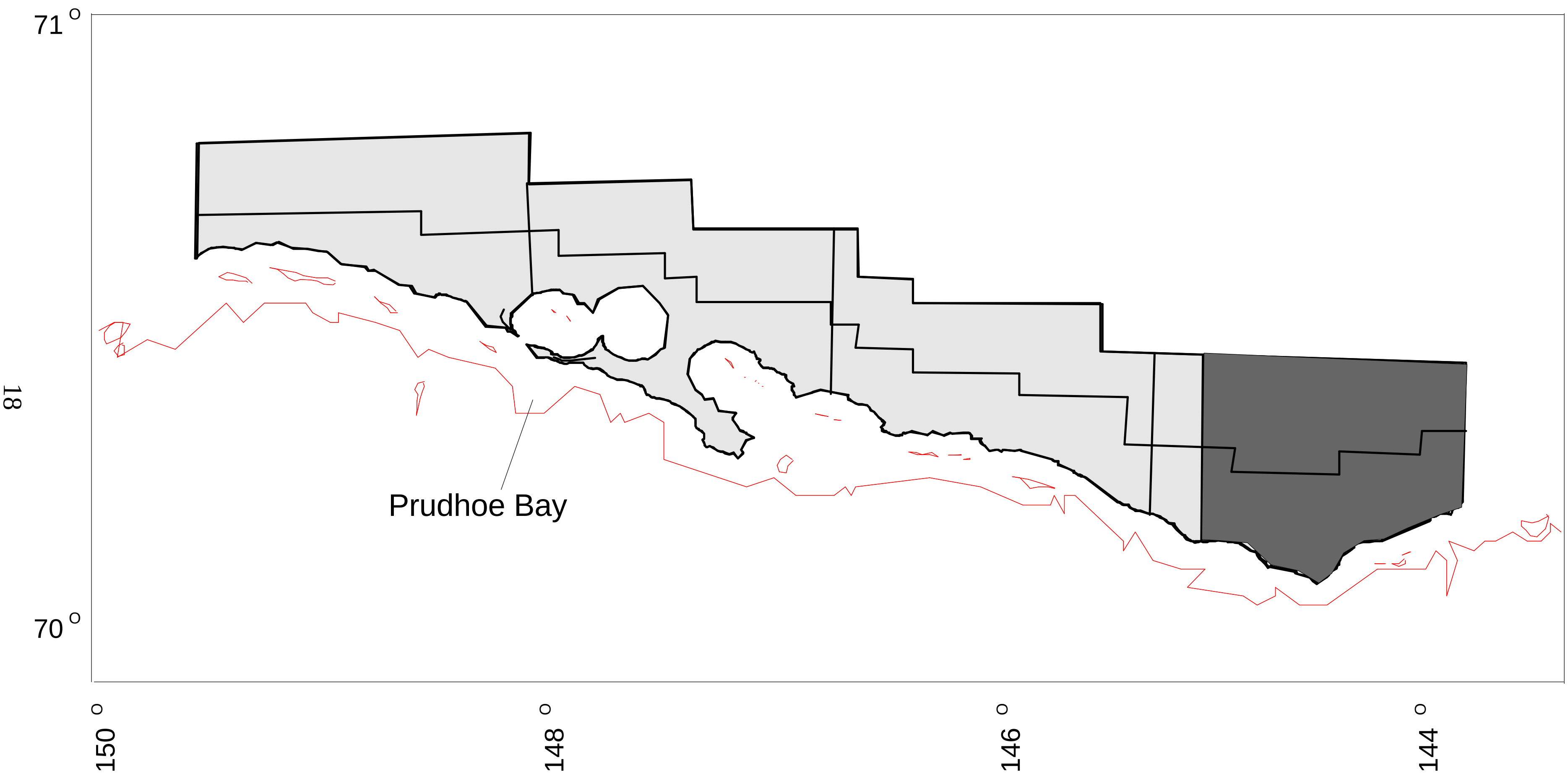

Figure 4. Enlarged representation of Kaktovik Deferral Alternative for proposed Beaufort Sea OCS Lease Sale 170
(hatching indicates deferral area).

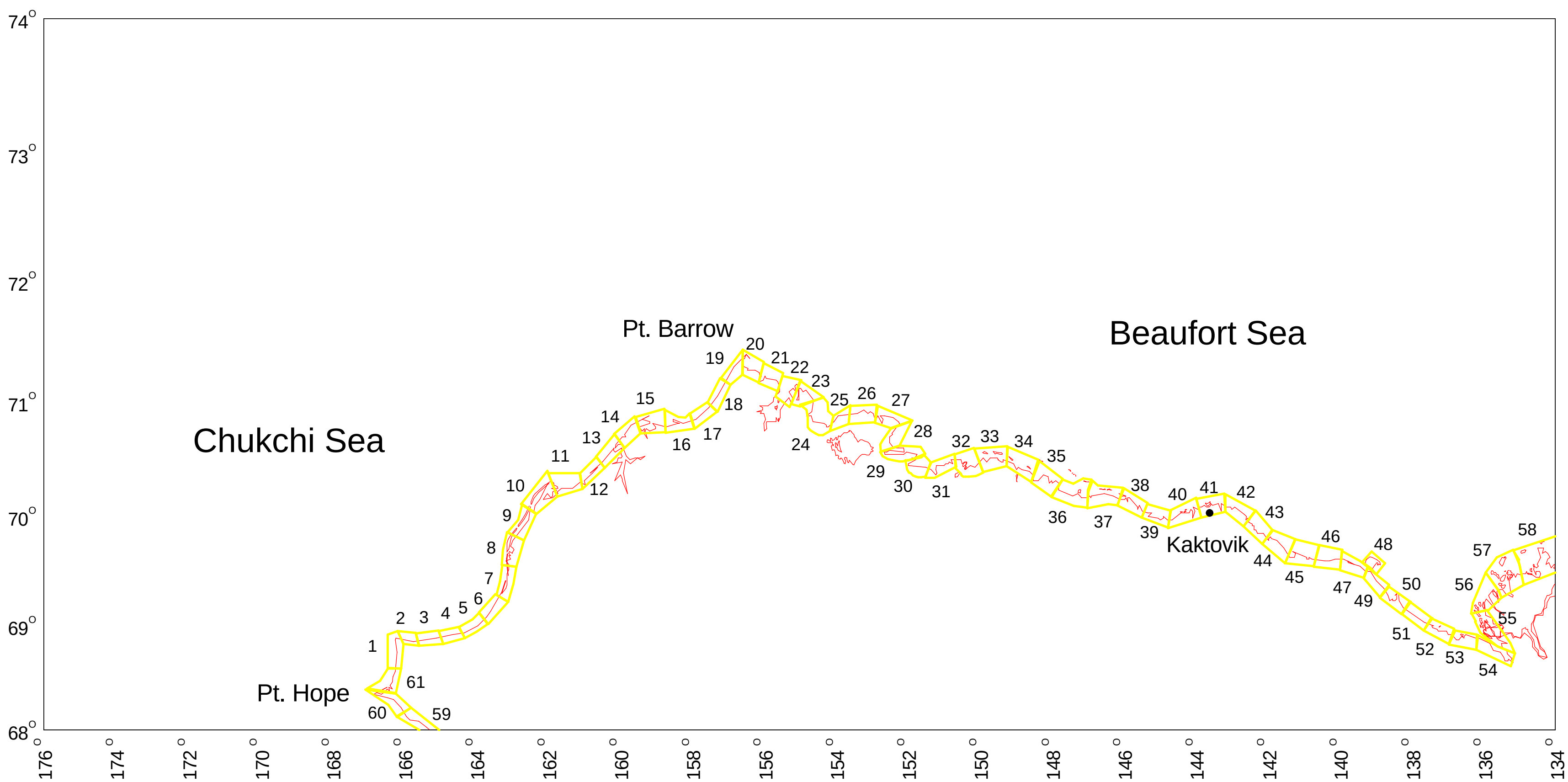

Figure 5. Study area coastline divided into 61 land segments for proposed Beaufort Sea OCS Lease Sale 170.

Table 1. Oil-spill occurrence probability estimates for spills greater than or equal to 1,000 barrels resulting over the assumed production life of the proposed action, Beaufort Sea OCS Lease Sale 170

Source	Probability of One or More Spills	Mean Number of Spills
Proposed Action		
Platforms	15-26%	0.16-0.30
Pipelines	37-59%	0.46-0.89
All Sources	46-70%	0.62-1.19
Kaktovik Deferral		
Platforms	13-22%	0.14-0.25
Pipelines	33-51%	0.40-0.72
All Sources	42-62%	0.54-0.97

Volume of Oil: 0.35-0.67 Bbbl (Proposed Action)
0.31-0.55 Bbbl (Kaktovik Deferral)

Table 2. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource area within 3 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	3	7	2	8	2	7	3	19	3	3	3	5	9	15	8
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 7	9	3	2	.	.	.	.	.	5	1	.	.	5	.	.
Ice/Sea Segment 8	6	3	51	5	7	1	.	.	4	12	3	.	1	6	1
Ice/Sea Segment 9	.	.	1	1	39	16	60	4	.	1	16	12	.	.	7
Ice/Sea Segment 10	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.
Ice/Sea Segment 11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	1	4	.	1	.	.	.	.	1	.	.	.	11	5	.
Gwydyr Bay	.	.	.	1	.	3	.	.	.	.	1	.	.	.	12
Jago Lagoon	.	.	.	.	.	.	1	8	.	.	.	2	.	.	.
Beaufort Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area C	80	**	50	**	70	83	6	2	**	**	87	5	**	**	**
Subsis. Res. Area D	1	2	18	48	78	**	**	**	2	38	**	**	.	6	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown.

Table 3. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource area within 10 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	8	12	7	14	8	13	8	26	8	9	9	11	15	20	15
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 6	2	1	1	.	.	.	.	.	1	1	.	.	2	.	.
Ice/Sea Segment 7	15	7	5	2	1	1	.	.	10	3	1	.	9	3	1
Ice/Sea Segment 8	9	6	55	9	11	4	1	1	8	18	6	1	4	10	4
Ice/Sea Segment 9	1	1	3	4	42	19	64	8	1	3	20	18	1	2	11
Ice/Sea Segment 10	.	.	1	1	3	2	6	3	.	1	3	4	.	1	2
Ice/Sea Segment 11	.	.	.	.	.	1	2	2	.	.	.	2	.	.	1
Ice/Sea Segment 12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	2	5	1	1	.	.	.	.	3	1	.	.	12	5	.
Gwydyr Bay	.	.	1	2	1	3	.	.	.	1	1	1	.	1	13
Jago Lagoon	.	.	.	.	1	2	3	9	.	.	1	4	.	.	1
Beaufort Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area C	84	**	58	**	75	85	14	4	**	**	89	9	**	**	**
Subsis. Res. Area D	3	5	21	50	81	**	**	**	5	40	**	**	2	9	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown.

Table 4. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource area within 30 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	13	20	12	21	14	21	15	35	14	14	15	18	22	26	23
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 5	1	.	.	.	.	.	.	.	1	.	.	.	1	.	.
Ice/Sea Segment 6	6	4	2	1	1	.	.	.	3	1	1	.	5	1	.
Ice/Sea Segment 7	22	11	10	5	2	1	1	1	16	7	2	1	13	6	1
Ice/Sea Segment 8	12	9	61	14	17	7	3	1	12	26	11	2	6	13	7
Ice/Sea Segment 9	2	2	4	5	44	22	70	11	3	4	27	25	1	3	13
Ice/Sea Segment 10	1	1	2	3	5	5	10	5	1	2	5	8	1	2	3
Ice/Sea Segment 11	.	.	1	1	2	2	4	3	.	1	2	4	.	.	1
Ice/Sea Segment 12	.	.	.	.	.	.	1	1	.	.	.	1	.	.	.
Ice/Sea Segment 13	.	.	.	.	1	1	1	1	.	.	1	1	.	.	1
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	3	7	2	2	1	.	.	.	4	3	.	.	15	7	.
Gwydyr Bay	.	1	1	3	1	4	1	1	1	2	1	1	.	1	15
Jago Lagoon	.	.	1	1	2	3	4	12	.	1	2	5	.	1	2
Beaufort Lagoon	.	.	.	.	.	.	1	1	.	.	.	1	.	.	.
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area C	87	**	68	**	80	88	26	8	**	**	92	20	**	**	**
Subsis. Res. Area D	5	7	24	53	84	**	**	**	8	44	**	**	4	13	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Boundary Segment 2	.	.	.	.	.	1	1	1	.	.	1	1	.	.	.

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown.

Table 5. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource area within 180 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	26	44	23	44	29	46	29	58	28	29	34	37	50	51	51
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	1	.	1	.	1	1	1	.	1	1	1	1	.	.	.
Ice/Sea Segment 5	2	1	1	1	1	1	1	.	1	1	1	.	1	1	.
Ice/Sea Segment 6	18	11	5	2	2	1	1	1	9	3	2	1	14	1	1
Ice/Sea Segment 7	48	28	25	15	3	2	2	1	36	20	3	2	28	16	3
Ice/Sea Segment 8	25	25	80	37	37	19	8	4	34	59	32	6	18	32	16
Ice/Sea Segment 9	4	4	6	10	54	42	87	37	6	7	48	61	3	4	31
Ice/Sea Segment 10	5	3	9	8	16	13	32	17	6	8	15	22	2	5	8
Ice/Sea Segment 11	.	.	4	1	8	7	13	9	2	5	6	10	.	.	6
Ice/Sea Segment 12	.	.	.	.	2	3	6	5	.	.	3	5	.	.	3
Ice/Sea Segment 13	.	.	.	.	1	1	2	2	.	.	1	3	.	.	1
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	6	15	7	7	3	1	.	.	9	10	2	.	20	14	1
Gwydyr Bay	.	1	2	8	3	9	3	2	2	5	3	4	.	5	21
Jago Lagoon	.	.	1	1	5	6	9	21	.	1	6	13	.	1	2
Beaufort Lagoon	.	.	.	.	.	.	1	1	.	.	.	1	.	.	.
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	2	1	1	1	1	.	.	.	1	1	.	.	1	1	.
Subsis. Res. Area C	90	**	78	**	88	92	47	26	**	**	96	49	**	**	**
Subsis. Res. Area D	10	20	32	67	88	**	**	**	22	56	**	**	5	33	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	3	4	.	.	.	4	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	1	1	1	1	1	1	1	.	1	1	1	1	1	.	1
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Boundary Segment 2	.	.	.	.	.	1	1	1	.	.	1	1	.	.	.

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown.

Table 6. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 3 days, Beaufort Sea OCS Lease Sale 170

Land Segment	Hypothetical Spill Location L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
32	1	1	.	.	.	.	.	.	.	.	.	.	2	.	.
33	1	2	.	.	.	.	.	.	1	.	.	.	5	.	.
34	1	3	1	2	.	.	.	.	1	2	.	.	1	12	.
35	.	.	.	3	.	1	.	.	.	1	.	.	.	1	1
36	.	.	.	3	1	1	.	.	.	.	.	.	.	1	2
37	.	.	.	1	1	2	.	.	.	.	1	1	.	.	5
38	.	.	.	.	.	2	1	4	.	.	1	2	.	.	1
39	.	.	.	.	.	.	.	4	.	.	.	1	.	.	.
40	.	.	.	.	.	.	1	8	.	.	.	1	.	.	.
41	.	.	.	.	.	.	1	2	.	.	.	1	.	.	.

Notes: . = Less than 0.5%.
Rows with all values less than 0.5% are not shown.

Table 7. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 10 days, Beaufort Sea OCS Lease Sale 170

Land Segment	Hypothetical Spill Location L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
29	1	1	.	.	.	.	.	.	.	.	.	.	1	.	.
30	1	1	.	.	.	.	.	.	1	.	.	.	1	.	.
31	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.
32	1	2	.	.	.	.	.	.	1	.	.	.	3	.	.
33	1	3	1	.	.	.	.	.	2	1	.	.	6	.	.
34	1	3	2	3	1	.	.	.	2	3	1	.	2	14	.
35	1	1	1	4	1	1	.	.	1	2	1	.	.	2	1
36	.	.	1	4	1	2	1	.	1	1	1	.	.	2	3
37	.	.	1	1	1	3	1	1	.	1	2	2	.	1	6
38	.	.	.	.	1	3	2	6	.	.	2	3	.	.	2
39	.	.	.	.	.	1	1	5	.	.	1	1	.	.	.
40	.	.	.	.	1	1	1	9	.	.	1	2	.	.	1
41	.	.	.	.	1	1	2	4	.	.	.	2	.	.	.

Notes: . = Less than 0.5%.
Rows with all values less than 0.5% are not shown.

Table 8. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 30 days, Beaufort Sea OCS Lease Sale 170

Land Segment	Hypothetical Spill Location L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
28	1	1	.	.	.	.	.	.	.	.	.	.	1	.	.
29	2	1	.	.	.	.	.	.	1	.	.	.	1	.	.
30	1	1	.	.	.	.	.	.	1	.	.	.	2	.	.
31	1	1	.	.	.	.	.	.	.	.	.	.	1	.	.
32	1	2	1	.	.	.	.	.	1	.	.	.	3	.	.
33	2	4	2	1	.	.	.	.	2	1	.	.	7	.	.
34	2	5	3	4	1	1	.	.	2	5	1	.	2	16	1
35	1	2	1	6	2	2	1	.	1	2	3	.	2	2	2
36	1	1	1	4	2	3	1	.	2	1	2	1	1	2	4
37	.	.	1	2	1	4	2	1	.	2	2	3	.	2	8
38	1	1	1	1	2	5	2	9	1	1	3	4	.	.	3
39	.	.	.	.	1	1	1	6	.	.	1	1	.	.	1
40	.	.	.	.	1	2	2	11	.	.	2	3	.	.	1
41	.	.	.	.	1	1	3	5	.	1	1	3	.	.	1
42	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.

Notes: . = Less than 0.5%.
Rows with all values less than 0.5% are not shown.

Table 9. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain land segment within 180 days, Beaufort Sea OCS Lease Sale 170

Land Segment	Hypothetical Spill Location L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
23	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
27	1	1	.	.	.	.	.	.	.	.	.	.	1	1	.
28	3	3	1	1	1	.	.	.	2	1	.	.	2	2	.
29	8	6	3	1	1	.	.	.	9	2	.	.	8	1	.
30	2	3	1	.	.	.	.	.	2	1	.	.	7	.	.
31	1	1	.	.	.	.	.	.	.	.	.	.	2	.	.
32	1	4	2	1	.	.	.	.	2	1	.	.	5	2	.
33	2	8	4	3	2	1	.	.	3	4	1	.	10	3	1
34	2	8	4	11	5	4	2	.	3	7	4	1	4	27	3
35	2	3	1	10	5	7	3	1	1	2	7	3	7	3	7
36	1	4	1	5	2	8	4	3	3	1	5	4	1	3	11
37	.	.	2	6	2	6	3	4	.	4	3	7	.	6	14
38	1	1	1	2	2	9	3	16	1	2	3	4	.	.	5
39	.	.	.	.	2	4	1	6	.	.	2	1	.	.	7
40	.	.	.	.	4	4	3	15	.	.	5	6	.	.	1
41	.	.	.	.	1	1	6	8	.	1	1	7	.	.	1
42	.	.	.	.	.	.	2	1	.	.	.	1	.	.	.
43	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.

Notes: . = Less than 0.5%.
Rows with all values less than 0.5% are not shown.

Table 10. Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean), occurring and contacting a certain environmental resource area over the assumed production life of Beaufort Sea OCS Lease Sale 170

Environmental	Within 3 days		Within 10 days		Within 30 days		Within 180 days	
Resource Area	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Land	5- 9	0.0-0.1	8-15	0.1-0.2	12-21	0.1-0.2	23-40	0.3-0.5
Ice/Sea Segment 1	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 2	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 3	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 4	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
Ice/Sea Segment 5	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
Ice/Sea Segment 6	.- .	0.0-0.0	.- 1	0.0-0.0	1- 2	0.0-0.0	3- 5	0.0-0.0
Ice/Sea Segment 7	1- 2	0.0-0.0	2- 4	0.0-0.0	3- 6	0.0-0.1	8-14	0.1-0.2
Ice/Sea Segment 8	2- 5	0.0-0.0	4- 8	0.0-0.1	6-12	0.1-0.1	14-25	0.2-0.3
Ice/Sea Segment 9	5- 9	0.1-0.1	7-12	0.1-0.1	8-15	0.1-0.2	15-27	0.2-0.3
Ice/Sea Segment 10	.- .	0.0-0.0	1- 2	0.0-0.0	2- 4	0.0-0.0	6-11	0.1-0.1
Ice/Sea Segment 11	.- .	0.0-0.0	.- 1	0.0-0.0	1- 2	0.0-0.0	3- 5	0.0-0.1
Ice/Sea Segment 12	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	1- 2	0.0-0.0
Ice/Sea Segment 13	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0	.- 1	0.0-0.0
Ice/Sea Segment 14	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 15	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 16	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 17	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Seg. 1 SLS*	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Seg. 2 SLS*	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Seg. 3 SLS*	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Seg. 4 SLS*	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Peard Bay#	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Elson Lagoon***	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Simpson Lagoon***	1- 3	0.0-0.0	2- 3	0.0-0.0	2- 4	0.0-0.0	4- 8	0.0-0.1
Gwydyr Bay***	2- 3	0.0-0.0	2- 4	0.0-0.0	3- 5	0.0-0.0	4- 8	0.0-0.1
Jago Lagoon***	.- 1	0.0-0.0	1- 2	0.0-0.0	1- 2	0.0-0.0	2- 4	0.0-0.0
Beaufort Lagoon***	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Subsis. Res. Area A	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Subsis. Res. Area B	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
Subsis. Res. Area C	40-62	0.5-1.0	40-64	0.5-1.0	41-63	0.5-1.0	43-65	0.6-1.1
Subsis. Res. Area D	30-49	0.4-0.7	30-50	0.4-0.7	31-51	0.4-0.7	33-54	0.4-0.8
Fall Feeding Area+	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Summer Feed. Area 1++	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
Summer Feed. Area 2++	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Southern SLS Area	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Northern SLS Area	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
Northern SLS*	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0

Note: . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with values less than 0.5% probability of contacts within 30 days are not shown.
Environmental Resources are vulnerable year-round unless noted as shown below:
* May-June # June-October *** July-September + September-October ++ June-September

Table 11. Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean), occurring and contacting a certain land segment over the assumed production life of Beaufort Sea OCS Lease 170

	Within 3 days		Within 10 days		Within 30 days		Within 180 days	
Land Segment	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
28	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	1- 1	0.0-0.0
29	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	1- 3	0.0-0.0
30	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	1- 1	0.0-0.0
31	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
32	.- .	0.0-0.0	.- 1	0.0-0.0	.- 1	0.0-0.0	1- 2	0.0-0.0
33	1- 1	0.0-0.0	1- 1	0.0-0.0	1- 2	0.0-0.0	2- 3	0.0-0.0
34	1- 3	0.0-0.0	2- 3	0.0-0.0	2- 4	0.0-0.0	4- 8	0.0-0.1
35	.- 1	0.0-0.0	1- 1	0.0-0.0	1- 2	0.0-0.0	3- 6	0.0-0.1
36	.- 1	0.0-0.0	1- 2	0.0-0.0	1- 2	0.0-0.0	3- 5	0.0-0.1
37	1- 2	0.0-0.0	1- 2	0.0-0.0	2- 3	0.0-0.0	3- 6	0.0-0.1
38	.- 1	0.0-0.0	1- 2	0.0-0.0	1- 2	0.0-0.0	2- 4	0.0-0.0
39	.- .	0.0-0.0	.- 1	0.0-0.0	.- 1	0.0-0.0	1- 3	0.0-0.0
40	.- 1	0.0-0.0	1- 1	0.0-0.0	1- 1	0.0-0.0	1- 3	0.0-0.0
41	.- 1	0.0-0.0	.- 1	0.0-0.0	1- 1	0.0-0.0	1- 2	0.0-0.0

Note: . = Less than 0.5%
Rows with all values less than 0.5% are not shown.

Table 12. Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean), occurring and contacting a certain environmental resource area over the assumed production life of Beaufort Sea OCS Lease Sale 170, Kaktovik Deferral

Environmental	Within 3 days		Within 10 days		Within 30 days		Within 180 days	
Resource Area	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
US Land	4- 7	0.0-0.1	7-12	0.1-0.1	10-18	0.1-0.2	20-34	0.2-0.4
Ice/Sea Segment 1	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 2	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 3	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 4	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 5	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
Ice/Sea Segment 6	.- .	0.0-0.0	.- 1	0.0-0.0	1- 2	0.0-0.0	2- 5	0.0-0.0
Ice/Sea Segment 7	1- 2	0.0-0.0	2- 4	0.0-0.0	3- 6	0.0-0.1	8-14	0.1-0.1
Ice/Sea Segment 8	2- 4	0.0-0.0	4- 8	0.0-0.1	6-11	0.1-0.1	13-23	0.1-0.3
Ice/Sea Segment 9	4- 7	0.0-0.1	6- 9	0.1-0.1	7-11	0.1-0.1	12-19	0.1-0.2
Ice/Sea Segment 10	.- .	0.0-0.0	1- 1	0.0-0.0	2- 3	0.0-0.0	5- 8	0.0-0.1
Ice/Sea Segment 11	.- .	0.0-0.0	.- .	0.0-0.0	1- 1	0.0-0.0	2- 3	0.0-0.0
Ice/Sea Segment 12	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	1- 1	0.0-0.0
Ice/Sea Segment 13	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
Ice/Sea Segment 14	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 15	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 16	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Segment 17	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Seg. 1 SLS	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Seg. 2 SLS	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Seg. 3 SLS	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Ice/Sea Seg. 4 SLS	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Peard Bay	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Elson Lagoon	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Simpson Lagoon	1- 3	0.0-0.0	2- 3	0.0-0.0	2- 4	0.0-0.0	4- 8	0.0-0.1
Gwydyr Bay	1- 2	0.0-0.0	2- 3	0.0-0.0	2- 4	0.0-0.0	4- 6	0.0-0.1
Jago Lagoon	.- .	0.0-0.0	1- 1	0.0-0.0	1- 1	0.0-0.0	1- 2	0.0-0.0
Beaufort Lagoon	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Subsis. Res. Area A	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Subsis. Res. Area B	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
Subsis. Res. Area C	37-57	0.5-0.9	38-58	0.5-0.9	38-59	0.5-0.9	39-60	0.5-0.9
Subsis. Res. Area D	24-37	0.3-0.5	25-38	0.3-0.5	25-39	0.3-0.5	28-42	0.3-0.6
Fall Feeding Area	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Summer Feed. Area 1	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Summer Feed. Area 2	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Southern SLS Area	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0
Northern SLS Area	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
Northern SLS	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0

Note: . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with values less than 0.5% probability of contacts within 30 days are not shown.
Environmental Resources are vulnerable year-round unless noted as shown below:
* May-June # June-October *** July-September + September-October ++ June-September

Table 13. Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean), occurring and contacting a certain land segment over the assumed production life of Beaufort Sea OCS Lease 170, Kaktovik Deferral

	Within 3 days		Within 10 days		Within 30 days		Within 180 days	
Land Segment	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
28	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	1- 1	0.0-0.0
29	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	1- 3	0.0-0.0
30	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	1- 1	0.0-0.0
31	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0
32	.- .	0.0-0.0	.- 1	0.0-0.0	.- 1	0.0-0.0	1- 2	0.0-0.0
33	1- 1	0.0-0.0	1- 1	0.0-0.0	1- 2	0.0-0.0	2- 3	0.0-0.0
34	1- 3	0.0-0.0	2- 3	0.0-0.0	2- 4	0.0-0.0	4- 8	0.0-0.1
35	.- 1	0.0-0.0	1- 1	0.0-0.0	1- 2	0.0-0.0	3- 5	0.0-0.0
36	.- 1	0.0-0.0	1- 1	0.0-0.0	1- 2	0.0-0.0	2- 4	0.0-0.0
37	1- 1	0.0-0.0	1- 2	0.0-0.0	2- 3	0.0-0.0	3- 5	0.0-0.1
38	.- .	0.0-0.0	1- 1	0.0-0.0	1- 2	0.0-0.0	1- 2	0.0-0.0
39	.- .	0.0-0.0	.- .	0.0-0.0	.- .	0.0-0.0	1- 2	0.0-0.0
40	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0	1- 1	0.0-0.0
41	.- .	0.0-0.0	.- .	0.0-0.0	.- 1	0.0-0.0	1- 1	0.0-0.0

Note: . = Less than 0.5%
Rows with all values less than 0.5% are not shown.

Appendix A

Environmental Resource Areas

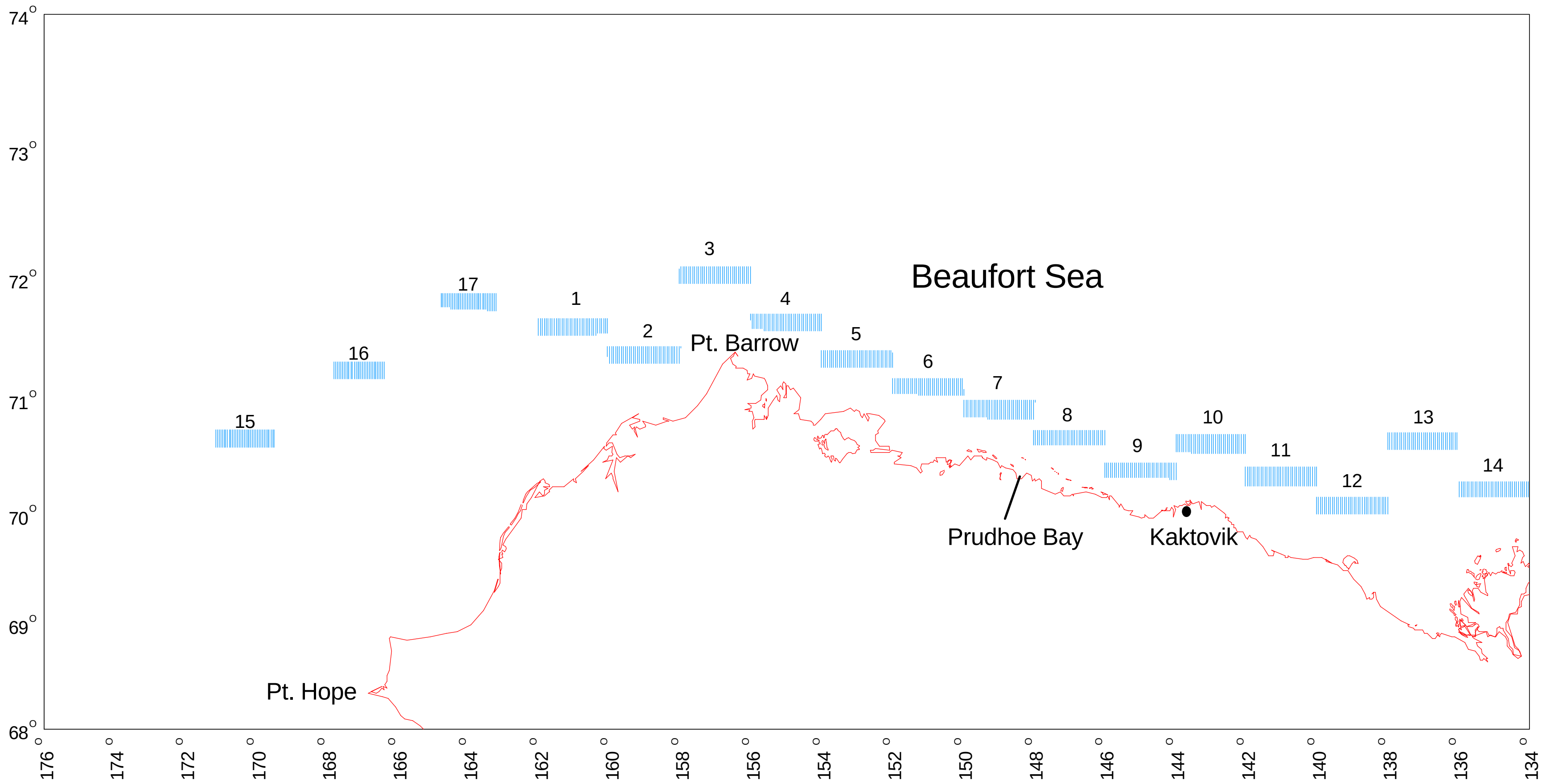

Figure A-1. Locations of Ice/Sea Segments 1-17 for proposed Beaufort Sea OCS Lease Sale 170.

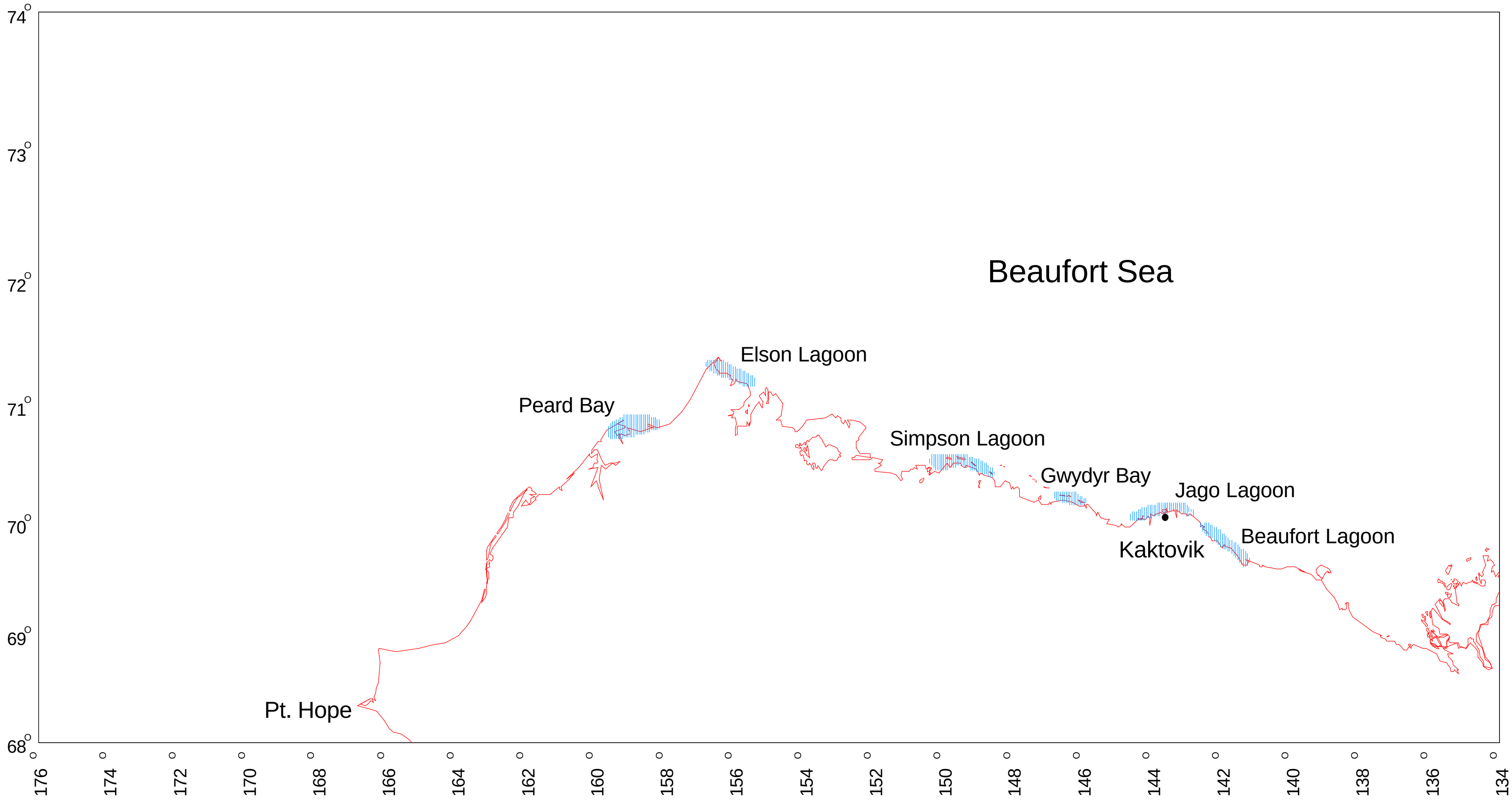

Figure A-2. Locations of Peard Bay, Elson Lagoon, Simpson Lagoon, Gwydyr Bay, Jago Lagoon, and Beaufort Lagoon for proposed Beaufort Sea OCS Lease Sale 170.

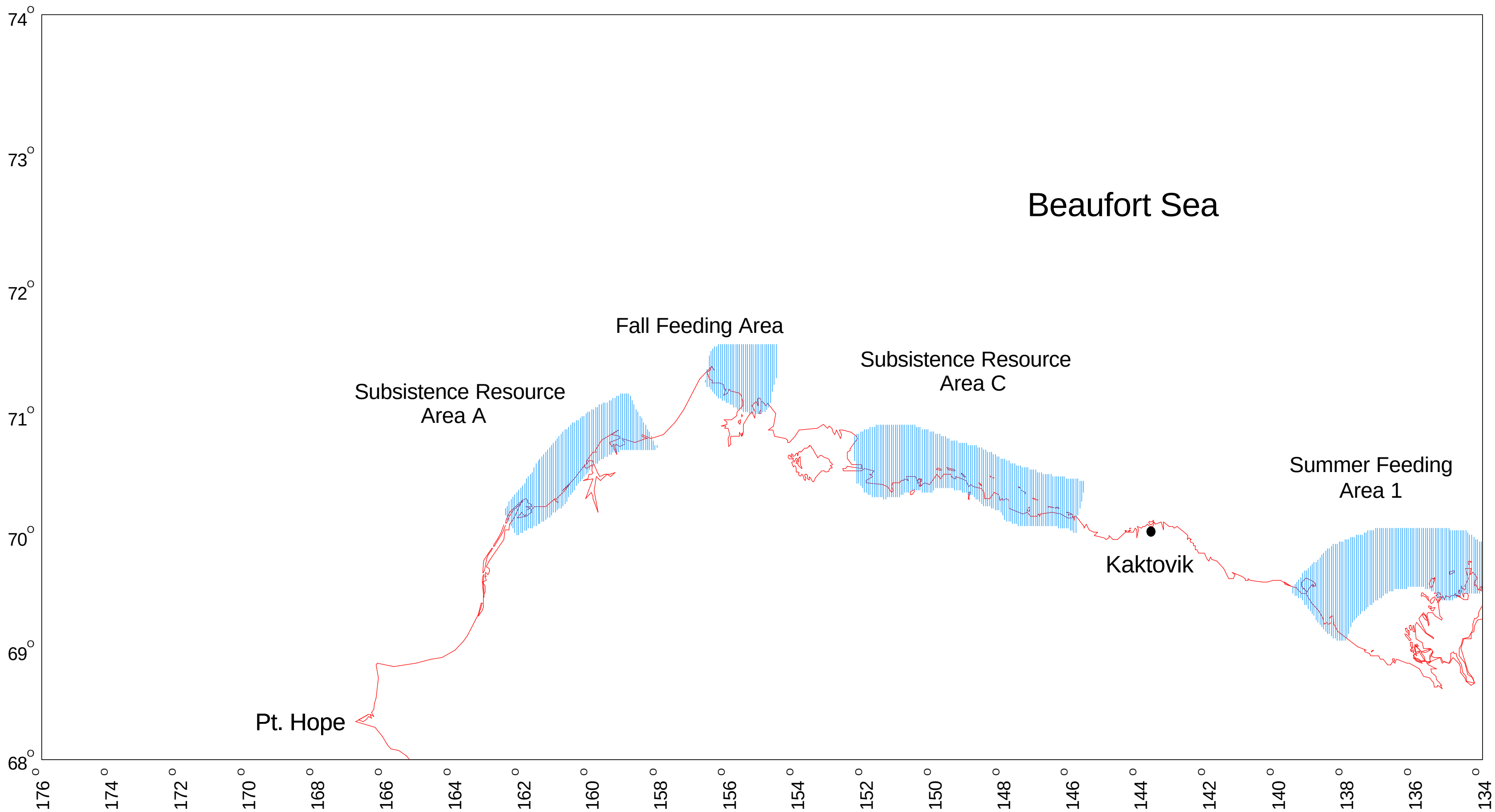

Figure A-3. Locations of Subsistence Resource Area A, Fall Feeding Area, Subsistence Resource Area C, and Summer Feeding Area 1 for proposed Beaufort Sea OCS Lease Sale 170.

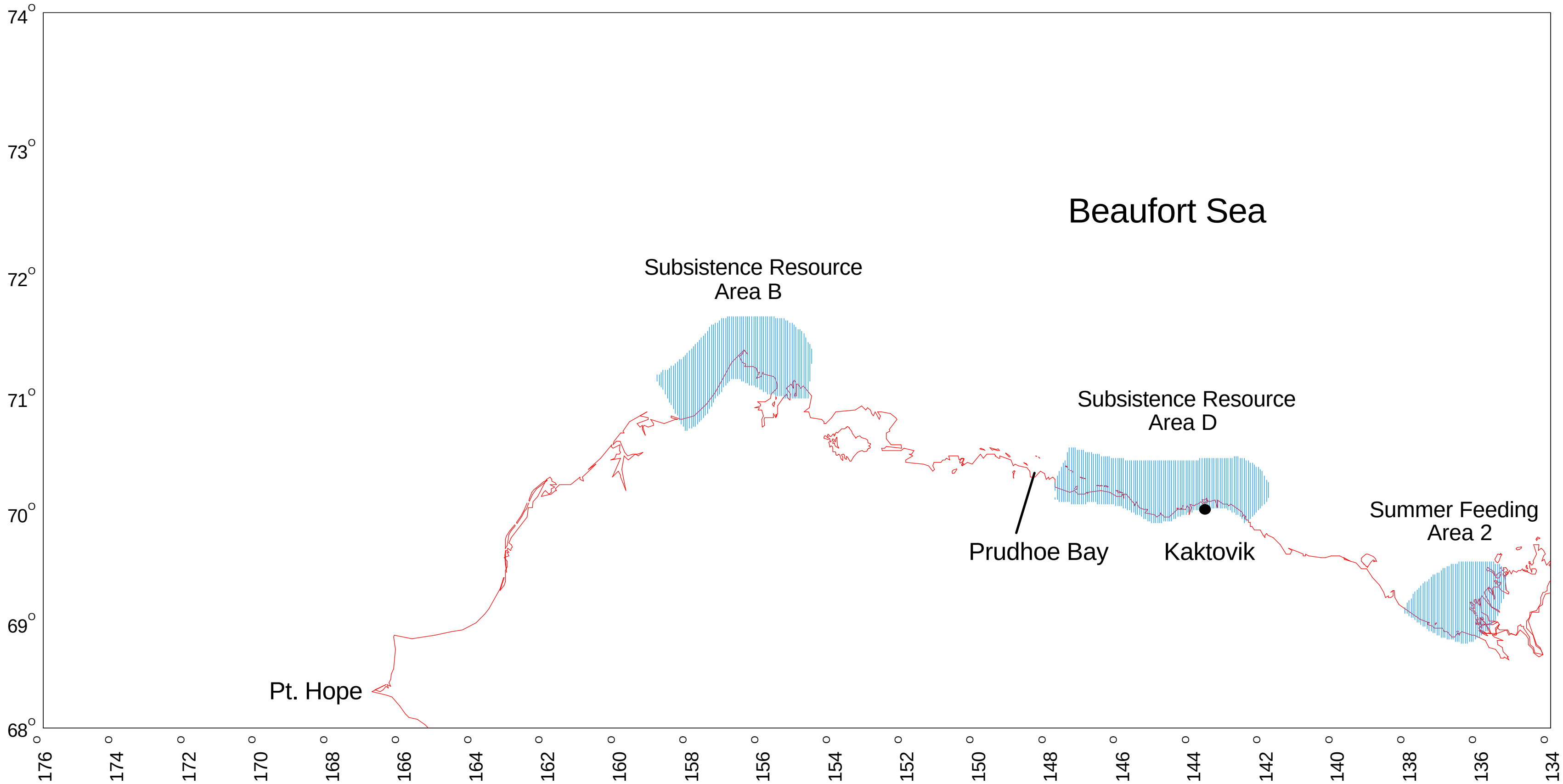

Figure A-4. Locations of Subsistence Resource Area B, Subsistence Resource Area D, and Summer Feeding Area 2 for proposed Beaufort Sea OCS Lease Sale 170.

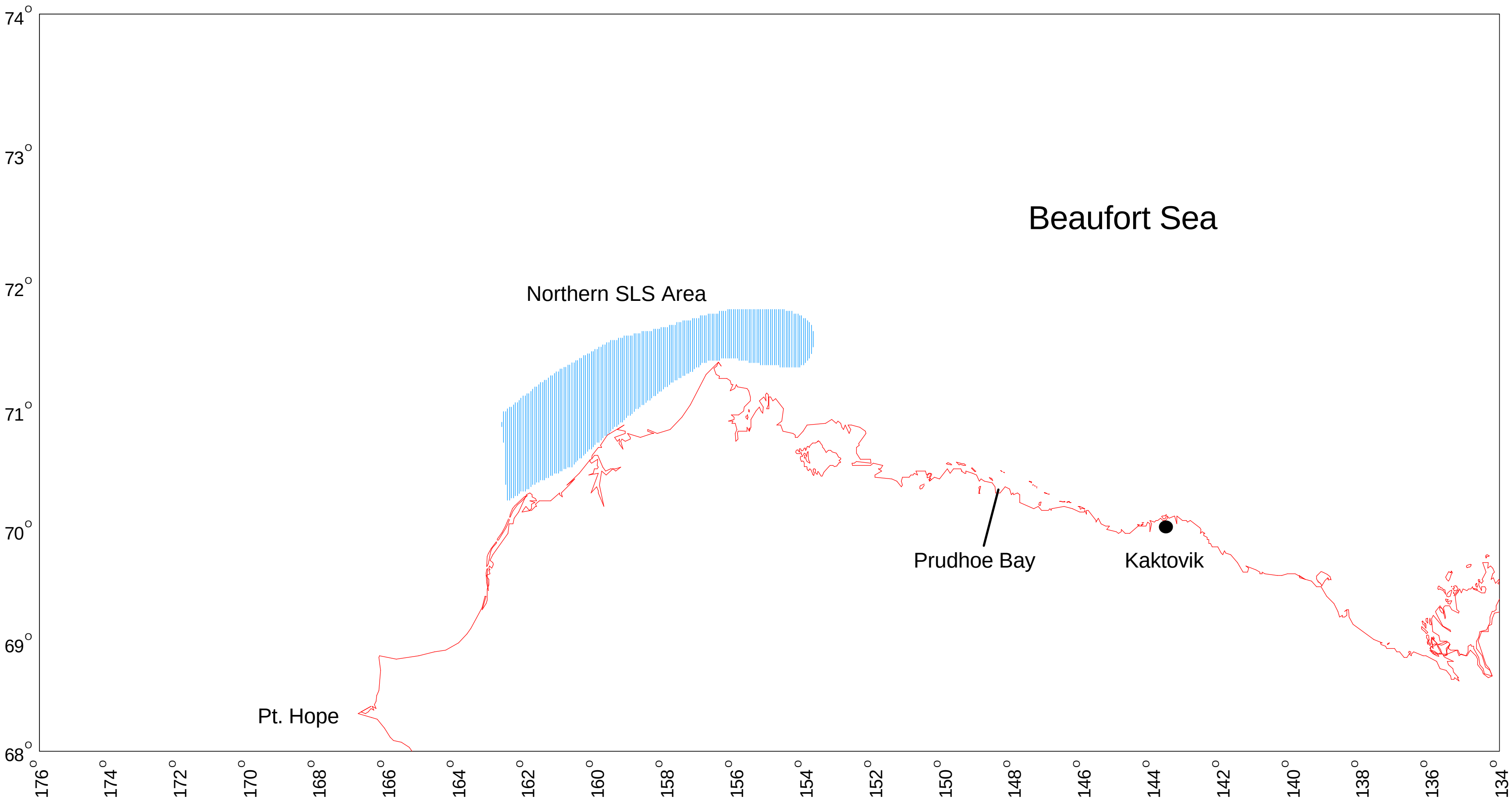

Figure A-5. Location of Northern Spring Lead System (SLS) Area for proposed Beaufort Sea OCS Lease Sale 170.

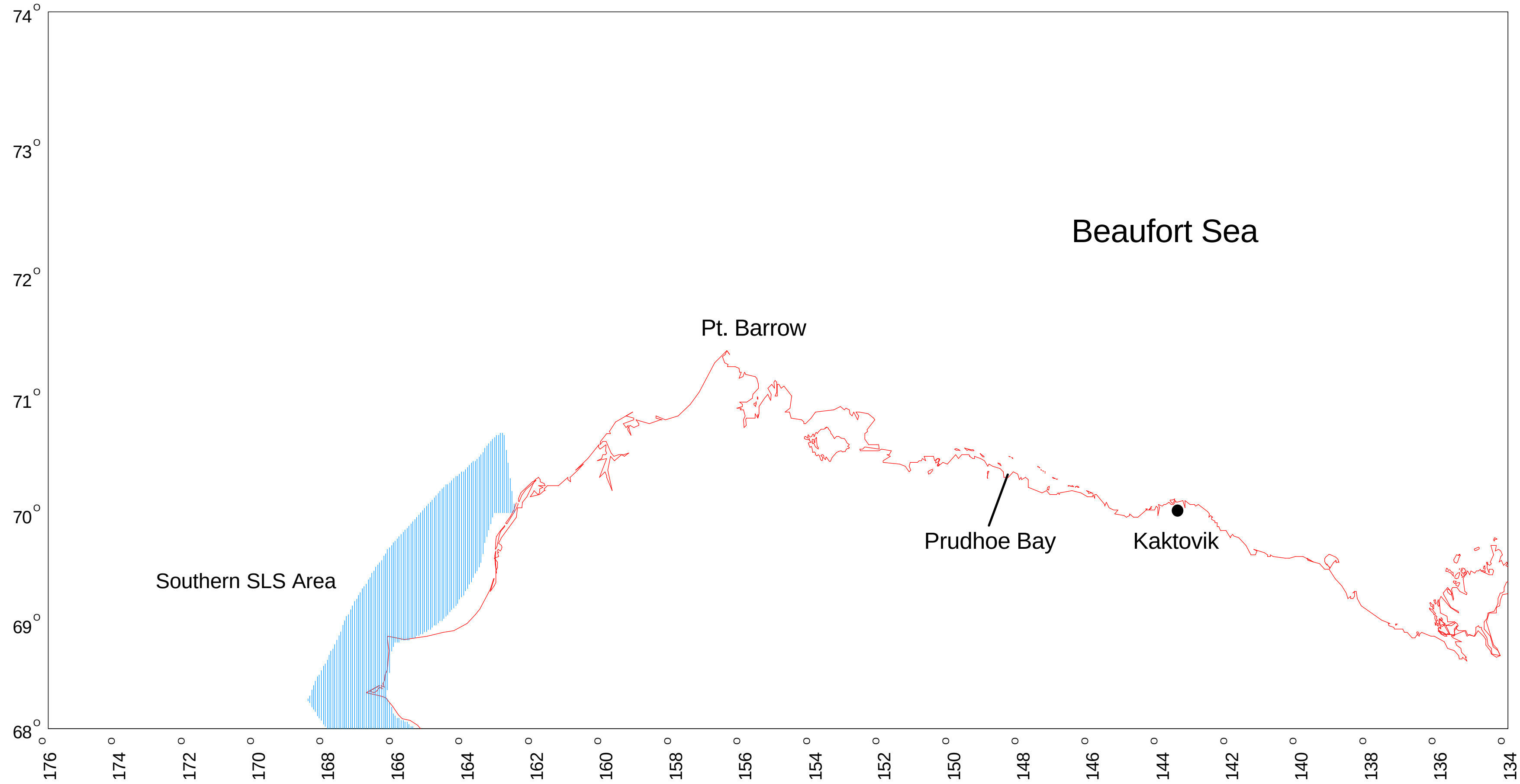

Figure A-6. Location of Southern Spring Lead System (SLS) Area for proposed Beaufort Sea OCS Lease Sale 170.

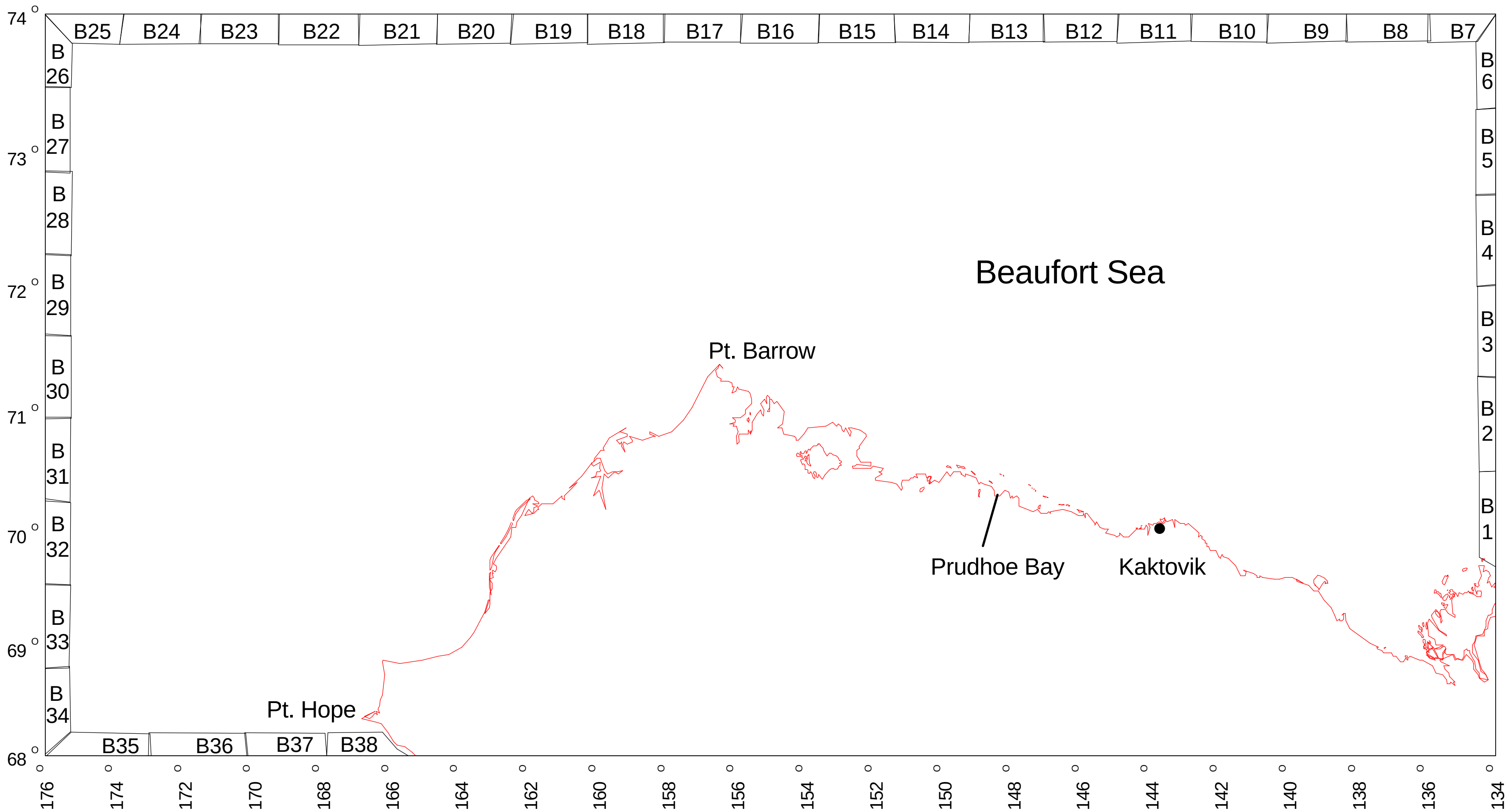

Figure A-7. Locations of Boundary Segments (B1-B38) for proposed Beaufort Sea OCS Lease Sale 170.

Appendix B

Seasonal Conditional Probabilities of Contact to Environmental Resource Areas

Table B-1. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource area within 3 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	2	5	2	7	2	6	2	17	3	3	2	4	9	14	6
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 7	4	1	1	.	.	.	.	.	2	1	.	.	2	.	.
Ice/Sea Segment 8	4	1	47	2	5	1	.	.	1	6	1	.	.	2	1
Ice/Sea Segment 9	.	.	.	.	37	12	57	2	.	.	10	5	.	.	2
Ice/Sea Segment 10	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Ice/Sea Segment 11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gwydyr Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jago Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Beaufort Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area C	80	**	50	**	70	83	6	2	**	**	86	5	**	**	**
Subsis. Res. Area D	.	.	16	44	77	**	**	**	.	34	**	**	.	2	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown

Table B-2. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource area within 10 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	6	9	5	11	5	9	6	22	6	6	6	7	12	16	10
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 6	1	1	1	.	.	.	.	.	1	1	.	.	1	.	.
Ice/Sea Segment 7	8	3	3	1	1	.	.	.	5	2	1	.	3	1	1
Ice/Sea Segment 8	5	2	51	4	8	2	1	1	2	11	3	1	1	4	2
Ice/Sea Segment 9	.	.	1	1	38	13	61	4	.	1	13	11	.	.	4
Ice/Sea Segment 10	.	.	.	.	1	.	1	.	.	.	.	1	.	.	.
Ice/Sea Segment 11	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Ice/Sea Segment 12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Gwydyr Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Jago Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Beaufort Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area C	83	**	58	**	75	85	16	4	**	**	89	9	**	**	**
Subsis. Res. Area D	1	1	17	45	81	**	**	**	1	35	**	**	.	3	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown

Table B-3. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource area within 30 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	8	13	6	14	7	13	7	27	7	7	7	10	14	17	13
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 5	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Ice/Sea Segment 6	3	1	1	.	.	.	.	.	1	1	.	.	2	1	.
Ice/Sea Segment 7	12	4	6	2	2	1	1	.	8	4	1	.	4	2	1
Ice/Sea Segment 8	5	2	54	5	11	2	3	1	3	16	5	1	1	5	2
Ice/Sea Segment 9	.	.	1	1	39	13	66	5	.	1	15	16	.	.	4
Ice/Sea Segment 10	.	.	.	.	1	1	2	1	.	.	1	1	.	.	.
Ice/Sea Segment 11	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.
Ice/Sea Segment 12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.
Gwydyr Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Jago Lagoon	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Beaufort Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area C	87	**	68	**	81	88	29	7	**	**	92	20	**	**	**
Subsis. Res. Area D	1	1	18	46	83	**	**	**	1	36	**	**	1	3	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown

Table B-4. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource area within 180 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	24	44	20	43	25	45	25	56	25	26	31	33	50	50	49
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	.	.	.	.	1	.	1	.	.	.	1	1	.	.	.
Ice/Sea Segment 5	2	1	1	.	1	1	1	1	1	1	1	1	1	.	.
Ice/Sea Segment 6	17	10	5	1	2	1	1	1	8	2	1	1	13	1	1
Ice/Sea Segment 7	45	24	25	14	3	1	1	1	33	19	2	1	23	15	2
Ice/Sea Segment 8	21	22	78	33	36	16	9	4	29	57	31	7	16	28	14
Ice/Sea Segment 9	2	2	3	6	50	37	88	39	4	5	42	63	1	1	26
Ice/Sea Segment 10	4	3	8	5	12	9	27	14	6	7	11	18	1	3	6
Ice/Sea Segment 11	.	.	3	1	6	6	10	6	3	4	5	8	.	.	4
Ice/Sea Segment 12	.	.	.	.	2	3	5	4	.	.	2	5	.	.	2
Ice/Sea Segment 13	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	4	10	6	7	3	1	.	.	6	9	1	.	9	10	1
Gwydyr Bay	.	.	1	6	2	5	2	2	1	3	3	4	.	5	11
Jago Lagoon	.	.	.	.	3	4	6	11	.	.	5	9	.	.	.
Beaufort Lagoon	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	2	1	1	.	1	.	.	.	1	1	1	.	1	.	.
Subsis. Res. Area C	91	**	81	**	92	94	56	32	**	**	98	59	**	**	**
Subsis. Res. Area D	6	16	28	63	88	**	**	**	17	50	**	**	2	28	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	3	3	.	.	.	3	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	1	.	1	.	1	1	1	.	1	.	1	1	.	.	.
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown

Table B-5. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain environmental resource area within 3 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	4	10	3	12	4	11	6	25	5	5	6	9	12	19	13
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 7	23	8	4	1	.	.	.	.	13	2	.	.	13	1	.
Ice/Sea Segment 8	12	10	63	15	13	3	.	.	14	29	8	.	5	16	2
Ice/Sea Segment 9	.	.	2	4	47	29	68	11	.	2	32	31	.	1	22
Ice/Sea Segment 10	.	.	.	.	1	.	5	1	.	.	1	2	.	.	1
Ice/Sea Segment 11	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.
Ice/Sea Segment 12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	4	16	1	2	.	.	.	.	5	2	.	.	44	19	.
Gwydyr Bay	.	.	.	3	2	10	1	1	.	1	3	1	.	.	46
Jago Lagoon	.	.	.	.	1	2	6	30	.	.	1	7	.	.	.
Beaufort Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area C	81	**	53	**	70	83	5	2	**	**	90	6	**	**	**
Subsis. Res. Area D	2	6	24	59	78	**	**	**	5	49	**	**	1	20	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown

Table B-6. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain environmental resource area within 10 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	13	21	13	25	15	26	17	38	15	17	19	22	23	33	30
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 5	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Ice/Sea Segment 6	6	3	1	.	.	.	.	.	3	1	.	.	4	.	.
Ice/Sea Segment 7	34	19	10	5	1	1	.	.	25	6	1	.	26	7	.
Ice/Sea Segment 8	21	20	70	26	21	11	3	1	25	42	15	2	15	28	11
Ice/Sea Segment 9	3	4	9	12	54	38	73	20	5	10	44	41	3	8	32
Ice/Sea Segment 10	1	2	3	5	10	9	18	9	1	3	12	13	1	4	7
Ice/Sea Segment 11	.	.	.	.	1	2	7	7	.	.	1	7	.	.	2
Ice/Sea Segment 12	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Ice/Sea Segment 13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	9	21	5	4	1	.	.	.	10	5	1	.	46	21	.
Gwydyr Bay	1	1	3	7	3	13	2	1	2	3	5	4	1	2	48
Jago Lagoon	.	.	1	2	5	7	11	36	.	1	5	15	.	1	5
Beaufort Lagoon	.	.	.	.	.	.	1	1	.	.	.	1	.	.	.
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area C	84	**	59	**	73	84	10	6	**	**	90	11	**	**	**
Subsis. Res. Area D	10	15	33	65	81	**	**	**	15	56	**	**	8	30	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown

Table B-7. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain environmental resource area within 30 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	31	40	30	42	36	46	38	59	32	34	40	45	44	50	53
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 5	2	1	1	.	.	.	.	.	1	.	.	.	1	.	.
Ice/Sea Segment 6	15	11	4	2	2	1	1	.	7	3	1	.	14	1	1
Ice/Sea Segment 7	51	33	21	15	4	3	2	1	39	16	4	2	39	18	2
Ice/Sea Segment 8	33	31	82	41	33	21	5	4	42	57	30	4	23	39	20
Ice/Sea Segment 9	8	7	14	18	62	50	81	29	9	13	62	53	5	12	41
Ice/Sea Segment 10	3	4	9	10	18	17	35	19	4	8	19	28	3	8	12
Ice/Sea Segment 11	.	1	2	2	6	6	13	12	.	3	6	13	1	2	6
Ice/Sea Segment 12	.	.	.	.	1	2	3	3	.	.	1	3	.	.	2
Ice/Sea Segment 13	.	.	.	2	3	4	6	5	.	1	3	6	.	1	4
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	12	28	8	7	2	1	.	.	16	11	1	.	51	25	1
Gwydyr Bay	2	3	5	11	5	17	4	2	3	6	6	6	1	6	50
Jago Lagoon	.	1	2	3	9	12	16	46	1	3	8	22	.	3	7
Beaufort Lagoon	.	.	.	.	1	1	3	2	.	1	1	2	.	.	1
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area C	87	**	66	**	78	87	17	10	**	**	92	18	**	**	**
Subsis. Res. Area D	17	25	41	74	86	**	**	**	28	67	**	**	12	43	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	.	1	1	.	.	.	1	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Boundary Segment 1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Boundary Segment 2	.	.	.	.	2	2	4	3	.	.	2	4	.	.	2
Boundary Segment 3	.	.	.	.	2	1	1	.	.	.	2	.	.	.	1

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown

Table B-8. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain environmental resource area within 180 days, Beaufort Sea OCS Lease Sale 170

Environmental Resource Area	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
Land	34	44	32	46	40	50	42	63	36	37	43	49	49	53	57
Ice/Sea Segment 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 3	1	1	1	1	.	.	.	.	2	1	.	.	1	1	.
Ice/Sea Segment 4	1	1	1	1	1	1	.	.	2	1	1	.	1	1	1
Ice/Sea Segment 5	3	2	2	2	1	1	.	.	3	2	1	.	2	1	1
Ice/Sea Segment 6	19	17	5	3	3	2	1	1	11	5	3	1	19	3	2
Ice/Sea Segment 7	58	40	26	21	6	4	3	2	46	21	5	3	45	22	4
Ice/Sea Segment 8	37	35	86	49	39	26	6	5	49	66	36	4	24	43	23
Ice/Sea Segment 9	9	10	15	19	64	55	84	33	9	13	67	57	7	12	44
Ice/Sea Segment 10	7	6	14	14	26	23	48	27	8	12	27	37	5	12	16
Ice/Sea Segment 11	1	1	6	3	11	11	20	16	1	8	10	17	1	2	10
Ice/Sea Segment 12	.	.	.	.	3	4	8	7	.	.	6	7	.	.	6
Ice/Sea Segment 13	.	.	.	2	3	4	6	6	.	1	3	6	.	1	4
Ice/Sea Segment 14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Segment 17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 1 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 2 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 3 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ice/Sea Seg. 4 SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peard Bay	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elson Lagoon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Simpson Lagoon	13	31	10	8	3	1	.	.	18	15	2	.	52	25	1
Gwydyr Bay	2	3	5	13	5	19	5	3	3	8	6	6	1	6	51
Jago Lagoon	.	1	2	3	10	13	18	48	1	3	8	24	.	3	7
Beaufort Lagoon	.	.	.	.	1	1	3	2	.	1	1	2	.	.	1
Subsis. Res. Area A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Subsis. Res. Area B	2	1	1	1	.	.	.	.	1	1	.	.	2	1	1
Subsis. Res. Area C	87	**	68	**	79	88	20	11	**	**	92	20	**	**	**
Subsis. Res. Area D	20	31	45	78	87	**	**	**	36	71	**	**	14	48	**
Fall Feeding Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Summer Feed. Area 1	.	.	.	.	.	1	4	5	.	.	.	5	.	.	.
Summer Feed. Area 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Southern SLS Area	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northern SLS Area	2	1	2	1	1	1	1	.	2	2	1	1	1	1	1
Northern SLS	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Boundary Segment 1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Boundary Segment 2	.	.	.	.	2	2	4	3	.	.	2	4	.	.	2
Boundary Segment 3	.	.	.	.	2	1	1	.	.	.	2	.	.	.	1

Notes: ** = Greater than 99.5%; . = Less than 0.5%; SLS = spring lead system.
Boundary Segments with all values less than 0.5% are not shown

Appendix C

Seasonal Conditional Probabilities of Contact to Land Segments

Table C-1. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain land segment within 3 days, Beaufort Sea OCS Lease Sale 170

Land Segment	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
32	1	1	.	.	.	.	.	.	.	.	.	.	3	.	.
33	1	2	.	.	.	.	.	.	1	1	.	.	4	.	.
34	.	2	1	2	.	.	.	.	1	2	.	.	1	11	.
35	.	.	.	2	.	1	.	.	.	1	.	.	.	1	1
36	.	.	.	3	.	1	.	.	.	.	.	.	.	1	2
37	.	.	.	.	.	2	.	.	.	.	1	1	.	.	3
38	.	.	.	.	.	2	1	5	.	.	1	1	.	.	.
39	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.
40	.	.	.	.	.	.	.	6	.	.	.	1	.	.	.
41	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.

Notes: . = Less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table C-2. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain land segment within 10 days, Beaufort Sea OCS Lease Sale 170

Land Segment	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
29	1	1	.	.	.	.	.	.	.	.	.	.	1	.	.
30	1	1	.	.	.	.	.	.	1	.	.	.	1	.	.
31	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
32	1	2	.	.	.	.	.	.	1	.	.	.	3	.	.
33	1	2	1	.	.	.	.	.	1	1	.	.	5	.	.
34	1	2	2	3	1	1	.	.	1	2	1	.	1	12	.
35	.	.	1	3	1	1	.	.	1	1	1	.	.	1	1
36	.	.	.	3	1	2	1	.	.	1	1	1	.	1	2
37	.	.	.	1	1	2	1	1	.	1	1	2	.	1	5
38	.	.	.	.	1	2	1	7	.	.	1	2	.	.	1
39	.	.	.	.	.	.	.	5	.	.	.	1	.	.	.
40	.	.	.	.	.	.	1	7	.	.	.	1	.	.	.
41	.	.	.	.	.	.	1	2	.	.	.	1	.	.	.

Notes: . = Less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table C-3. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain land segment within 30 days, Beaufort Sea OCS Lease Sale 170

	Hypothetical Spill Location														
Land Segment	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
28	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.
29	1	1	.	.	.	.	.	.	.	.	.	.	1	.	.
30	1	1	.	.	.	.	.	.	1	.	.	.	1	.	.
31	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
32	1	2	.	.	.	.	.	.	1	1	.	.	3	.	.
33	1	3	1	.	.	.	.	.	1	1	.	.	5	.	.
34	1	3	2	3	1	1	.	.	2	2	1	.	1	13	.
35	.	1	1	5	1	2	1	.	1	1	2	.	.	1	2
36	.	.	.	3	1	3	1	.	.	1	1	1	.	2	3
37	.	.	1	1	1	3	1	1	.	1	1	2	.	1	6
38	.	.	.	.	1	3	1	9	.	.	1	3	.	.	1
39	.	.	.	.	.	.	.	6	.	.	1	1	.	.	.
40	.	.	.	.	.	.	1	8	.	.	.	1	.	.	.
41	.	.	.	.	.	.	1	2	.	.	.	1	.	.	.

Notes: . = Less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table C-4. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain land segment within 180 days, Beaufort Sea OCS Lease Sale 170

	Hypothetical Spill Location														
Land Segment	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
23	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
27	1	1	.	.	.	.	.	.	.	.	.	.	1	.	.
28	4	4	2	1	1	.	.	.	2	1	.	.	3	2	.
29	9	7	4	1	1	.	.	.	11	3	1	.	10	1	.
30	2	4	1	.	.	.	.	.	2	1	.	.	7	1	.
31	1	1	.	.	.	.	.	.	.	.	.	.	2	1	.
32	1	4	2	1	.	.	.	.	2	2	.	.	6	3	.
33	1	8	4	4	2	1	.	.	2	5	1	.	9	4	1
34	1	8	3	12	5	5	2	.	2	6	5	1	3	27	4
35	2	3	1	10	5	9	3	1	1	1	8	3	8	2	8
36	.	4	1	5	2	8	4	4	2	1	5	5	.	2	12
37	.	.	2	6	1	6	3	5	.	3	3	7	.	6	13
38	.	.	1	2	1	8	2	19	.	2	2	3	.	.	3
39	.	.	.	.	2	3	.	6	.	.	1	1	.	.	8
40	.	.	.	.	3	3	2	13	.	.	5	4	.	.	.
41	.	.	.	.	1	.	5	6	.	.	.	6	.	.	.
42	.	.	.	.	.	.	2	1	.	.	.	1	.	.	.

Notes: . = Less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table C-5. Conditional probabilities (expressed as percent chance) that an oil **spill starting at a particular location in the summer season will contact a certain land segment within 3 days, Beaufort Sea OCS Lease Sale 170**

Land Segment	Hypothetical Spill Location L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
32	1	1	.	.	.	.	.	.	.	.	.	.	2	.	.
33	1	3	.	.	.	.	.	.	2	.	.	.	7	.	.
34	1	5	1	2	.	.	.	.	2	2	.	.	2	15	.
35	.	1	1	4	.	.	.	.	.	2	.	.	.	3	.
36	.	.	.	3	1	1	.	.	.	.	1	.	.	1	2
37	.	.	.	1	1	4	1	.	.	1	1	.	.	.	9
38	.	.	.	.	1	4	2	3	.	.	2	3	.	.	2
39	.	.	.	.	.	1	1	4	.	.	.	1	.	.	.
40	.	.	.	.	.	1	1	12	.	.	1	2	.	.	.
41	.	.	.	.	.	.	2	5	.	.	.	3	.	.	.

Notes: . = Less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table C-6. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain land segment within 10 days, Beaufort Sea OCS Lease Sale 170

Land Segment	Hypothetical Spill Location L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
29	1	1	.	.	.	.	.	.	1	.	.	.	1	.	.
30	1	1	.	.	.	.	.	.	.	.	.	.	1	.	.
31	1	1	.	.	.	.	.	.	.	.	.	.	1	.	.
32	2	2	.	.	.	.	.	.	1	.	.	.	3	.	.
33	2	5	1	1	.	.	.	.	4	.	.	.	9	.	.
34	3	7	4	5	.	.	.	.	4	6	.	.	5	21	.
35	1	2	2	6	2	2	.	.	2	4	2	.	1	4	1
36	.	1	1	5	3	3	.	.	2	2	3	.	1	3	5
37	.	1	1	4	2	5	1	1	1	3	2	2	.	2	11
38	.	.	1	1	2	7	4	6	.	1	5	5	.	1	5
39	.	.	.	.	1	2	2	5	.	.	1	2	.	.	1
40	.	.	.	1	2	4	3	15	.	.	3	5	.	1	3
41	.	.	.	1	2	2	5	9	.	1	2	5	.	.	1
42	.	.	.	.	.	.	1	1	.	.	.	1	.	.	.

Notes: . = Less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table C-7. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain land segment within 30 days, Beaufort Sea OCS Lease Sale 170

Land Segment	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
24	1	.	.	.	.	.	.	.	1	.	.	.	1	.	.
26	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.
27	1	1	1	1	.	.	.	.	.	1	1	.	1	1	.
28	2	1	.	1	.	.	.	.	1	.	.	.	2	.	.
29	4	2	1	.	.	.	.	1	4	.	.	.	2	.	.
30	1	2	.	.	.	.	.	.	.	.	.	.	4	.	.
31	2	1	.	.	.	.	.	.	1	.	.	.	3	.	.
32	2	2	1	.	.	.	.	.	2	.	.	.	3	.	.
33	3	6	4	1	1	.	.	.	5	1	.	.	12	1	.
34	5	10	6	8	3	1	.	.	5	11	.	.	7	27	1
35	4	5	3	8	4	3	1	.	2	5	6	1	5	4	2
36	2	4	2	5	4	5	1	.	5	2	4	.	2	5	8
37	1	1	3	7	3	6	2	1	1	5	3	5	1	5	16
38	2	2	3	3	4	9	5	8	2	3	8	7	2	2	8
39	.	1	1	1	2	4	2	5	1	.	1	2	.	.	4
40	.	.	1	1	4	6	5	19	.	1	6	9	.	1	3
41	.	1	2	2	3	3	8	13	1	2	2	9	.	2	3
42	.	.	.	1	1	1	2	2	.	1	1	1	.	1	1
43	.	.	.	1	1	1	1	1	.	1	2	1	.	.	1
44	.	.	.	.	.	1	2	1	.	.	1	1	.	.	1
45	.	.	.	.	.	.	1	1	.	.	.	1	.	.	.

Notes: . = Less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table C-8. Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain land segment within 180 days, Beaufort Sea OCS Lease Sale 170

Land Segment	Hypothetical Spill Location														
	L1	L2	L3	L4	L5	L6	L7	L8	P1	P2	P3	P4	P5	P6	P7
24	1	.	.	.	.	.	.	.	1	.	.	.	1	.	.
26	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.
27	1	1	1	1	.	.	.	.	.	1	1	.	1	1	.
28	2	1	.	1	.	.	.	.	1	.	.	.	2	.	.
29	5	2	1	.	.	.	.	1	6	.	.	.	2	.	.
30	2	2	1	.	.	.	.	.	.	.	.	.	4	.	.
31	2	1	.	.	.	.	.	.	1	.	.	.	4	.	.
32	2	2	1	.	.	.	.	.	2	.	.	.	3	.	.
33	3	7	5	1	1	.	.	.	5	2	.	.	13	1	.
34	5	11	6	9	3	1	.	.	5	11	2	.	8	27	1
35	4	5	3	9	5	3	1	.	2	5	6	1	6	4	2
36	2	5	2	6	4	6	2	.	7	2	4	.	2	5	8
37	1	1	4	9	3	7	3	2	1	7	3	5	1	7	18
38	2	2	3	4	4	10	5	9	2	3	8	8	2	2	10
39	.	1	1	1	3	4	2	5	1	.	3	2	.	.	4
40	.	.	1	1	6	7	5	20	.	1	6	10	.	1	3
41	.	1	2	2	3	3	9	14	1	2	2	11	.	2	3
42	.	.	.	1	1	1	2	2	.	1	1	1	.	1	1
43	.	.	.	1	1	1	2	1	.	1	2	1	.	.	1
44	.	.	.	.	.	1	2	1	.	.	1	1	.	.	1
45	.	.	.	.	.	.	1	1	.	.	.	1	.	.	.

Notes: . = Less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.